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THE AMERICAN GAS LIGHT JOURNAL

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CONTENTS

An Asterisk (*) denotes an illustrated article.

EDITORIALS —

Briefly Told 921
The State of Trade—Mr. Brackenridge's X-Rays on the Gas Bill—Notes.

Gas as a Cause of Fires 922

*The Illumination of Inclosed Space.—No. 2.—An Attempted Solution of the Special Case Described, by Dr. W. H. Birchmore... 922

A Comparison of Various Rapid Methods for Determining Carbon Dioxide and Carbon Monoxide—Concluded from page 892..... 924

Reduction in Cost of Steam Power from 1870 to 1897, by Mr. F. W. Dean..... 925

*The Mitchell and Harleman Gas Producer..... 928

The Brick Industry of Fletton, England..... 930

Natural Gas in Canada..... 930

Some Random Notes upon Florida Gas Works, by Traveler..... 931

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 932
Cheaper Gas for Des Moines, Iowa—Changes and Appointments, Buffalo, N. Y.—Gas for Ludlow, Ky.—To Light the County Buildings, Poughkeepsie, N. Y.—Gas Power for Vassar College—Public Lighting, Jersey City, N. J.—Cheaper Gas for Trenton, N. J.—Sued the Belvidere (Ills.) Company—Mr. E. H Jenkins to Take Charge at Buffalo, N. Y.—Contract for the Berlin Iron Bridge Company—The Paris (Ills.) Company's Contention Sustained—Something from Cartersville, Ga.—Adjusting Interest Payments, Salt Lake, Utah—Stock of the Newark (N. J.) Company Increased—The Goshen (N. Y.) Plant to be Sold—Mr. Hantzman Has Resigned—The Peoples Gas Light and Coke Company, Buffalo, N.Y.—To Examine the Quality of Mount Vernon (N. Y.) Gas—The London Fire—And Other Items.

On the Impurities of Commercial Carbide of Calcium..... 934

The Market for Gas Securities..... 934

BRIEFLY TOLD.

THE STATE OF TRADE.—The figures so far received by us respecting the quantities of gas sent out in certain districts, during the months of September, October and November, 1897, as compared with the sendout in the same places during the corresponding months of 1896, are more than satisfactory, since they almost invariably reveal gains that are substantial. Of the 26 places reporting, only one shows a loss—the shrinkage amounting to 3.6 per cent.—and that exception to the rule is accompanied by an explanation which goes to show that that loss is really a gain, paradoxical as such putting of the case may seem. The paradox, however, ceases when the remark is made that, as a consequence of certain well-directed work in main overhauling, the leakage account has been reduced from something over 13 per cent. to a level 7½ per cent. We would like to elaborate on this particular return, for the gentleman who makes it has reported some queer uncoverings; one instance of the latter serving to account for perhaps 30 per cent. of the 13 per cent. loss. The case is well enough known in and about his district to insure the revealing of his Company's identity if more were here said about it; but the further likelihood is that more will be said about it, and by himself, at the next meeting of the New England Association of Gas Engineers. The 26 places reporting (the total sendout by the 26 amounted to 375,000,000 cubic feet for the quarter) show a gain that figures 10.22 per cent. A notable feature of the returns (which feature was brought out clearly in six examples) is the fact that the average consumption on cooking account, expressed in cubic feet per month, rose, from 1,800 feet in the '96 quarter, to 2,100 feet in the '97 quarter. In the six cases last mentioned separate meters for other than illuminating use are maintained. The returns, as a whole, are convincing that the gas industry is more than keeping pace with the general (though even-paced) advance or betterment now underway commercially throughout the country.

MR. BRACKENRIDGE'S "X-RAYS ON THE GAS BILL."—Some measure of appreciation has been vouchsafed to the proposition advanced in the last issue of the JOURNAL, that the article which then appeared, under the name of Mr. James Brackenridge, might be worth arranging in pamphlet form for free distribution amongst their consumers by gas companies throughout the country. At the time of writing we have received orders for 20,000 copies, but that the JOURNAL'S offer to put the pamphlet on the market at the price of $4 per 1,000 may be kept, it will be necessary that orders for the full edition of 50,000 shall be booked. The orders at hand have been accompanied by hearty expressions of approval over the way in which Mr. Brackenridge treated his theme, and it is to be hoped that in short time the full complement of demands for his pamphlet will have been received, so that it may be distributed by the purchasers to their customers at the time and during the season when, through the continuance of lengthy times of artificial lighting, the attention of such customers is most forcibly attracted to their bills for dispelling darkness, to the end that their offices, stores and homes may be all the more tenantable or attractive.

NOTES.—The name of the firm of Riter & Conley, of Pittsburgh, Pa., has been changed to that of the Riter-Conley Company. No change has been made in the offices of the concern.——Mr. P. S. Florea, Receiver of the Connersville (Ind.) Gas and Electric Company, informs us that all the properties of that concern will be disposed of on January 27, 1898. Between now and then he will furnish any information anent the subject.——The Directors of the Spencer (Mass.) Gas Company have ordered an increase in the gas rate, to $2 per 1,000, from $1.60.——A correspondent at Norfolk, Va., writing under date of the 8th inst., says: "I wired you to-day about the boiler explosion at the works of the Citizens Light, Heat and Power Company, of Portsmouth, Va. It happened yesterday afternoon, at 3:50. I was informed that it was a Westinghouse outfit, by E. Kendall & Sons, of Charlestown, Mass. This was not the Portsmouth Gas Company's electric annex, but the plant of the opposition electric company. I was over this morning, and found an awful wreck. It looked that hardly one brick rested on another. The whole thing was a mass of ruins. The dynamos were buried under the debris, and one cannot say how badly they are damaged; but the boiler, which seemed to me to have been well constructed out of good material, was reposing, about 100 feet away from its original bed, in a wood yard. It was torn in two—an unusual way for such a boiler (tubular) to go. In my judgment, lack of water was the cause, although at the inquest the testimony went to show that the gauges proved plenty of water, and only 95 pounds steam, just a few minutes

before the explosion occurred. The colored fireman, in charge of the plant at the time, was killed outright; a second laborer received injuries which are bound to result fatally, while a third hand was badly bruised. Supt. White, the hustling man of the Portsmouth Gas Company, was found busily working to furnish light—either gas or electric—to everybody who had been supplied from the wrecked plant."

Gas as a Cause of Fires.

The London *Journal* says: The extensive fire which raged in the city on the 19th November has directed attention to the sources of fires in towns, and in the daily papers disparaging references to gas have been frequent. Often an overt or covert eulogium of electric lighting accompanied the reference; and the casual reader was left to infer that gas was a fruitful source of outbreaks of fire, while benign electricity never was guilty of such base behavior. Whatever may have been the origin of the recent disastrous fire—and certainly nothing definite was known at the time the references in the press were penned—the careful journalist would have turned to statistics for support of the charges he leveled against gas as a predominant disseminator of fires. Unfortunately, it is not the fashion with a certain section of latter day journalists to authenticate statements which may serve to garnish topical articles or paragraphs. Electricity is still the pet of these writers, with whom it is a dictum that the "subtle fluid," to use their *argot*, can do no wrong. Moreover, established interests, as represented by the Metropolitan Gas and Water Companies, must be abused—justly if opportunity offers, but unjustly if that be, as it usually is, the easier course open to the unscrupulous contributor. Had statistics been consulted by some of the pressmen who were responsible for the comments in the daily papers on the great fire in the city, the public would have been spared many a wrong impression on the relative dangers of gas and electric lighting. As it is, it behoves us to correct the hasty statements of the lay pressmen by a reference to published and authentic particulars.

Statistical information is most complete in Germany, and we naturally turn first to German papers for a confirmation or contradiction of the view that gas is a more common source of fire than is electricity. The Germans, who individually and collectively revel in statistics, do not fail us; for, in the number of the *Journal für Gasbeleuchtung* published on the morrow of the great city fire, we find a paper by Herr A. Müller, of Charlottenburg, on "The Comparative Risk of Fre from Electrical and Gas Installations." We learn from the introductory portion of the paper that electricians in Germany, like their brethren here, loudly proclaim the security from fire enjoyed by those who use the electric light in place of gas. Herr Müller proceeds to consider if the assertions are well grounded.

Gas lighting at the Industrial Exhibition in Berlin last year was to have been wholly avoided according to the original plans; and it was only with difficulty that the gas industry obtained the use of a special structure wherein to display lighting apparatus. Finally, in addition to this large building, the square in front of it, the road leading therefrom to the Cöpenick Highway, as well as the latter, and several restaurants in "Old Berlin," were lighted by gas. This extensive installation was responsible for one "small" fire, caused by a gas tap in a cellar being left open. The remaining parts of the Exhibition were lighted by electricity only, and no fewer than eleven "small" fires, one "moderate" fire, and one "large" fire occurred. The majority of these were caused either by faulty conductors or by short circuiting.

Turning to towns where the origin of a fire is not so easily traced, we find that the Berlin Fire Brigade reported 37 fires due to gas, and 14 due to the electric light in the year 1894–5. Taking into account the numbers of consumers of gas and electricity, these figures point to gas being by far the safer illuminant. In the same period, 92 fires were attributed to oil and candle lighting. The superiority of gas is clearly shown in these two instances; and if further proof of the mythical nature of the security from fire which electric lighting is alleged to impart were needed, it is afforded by a recent decision of the insurance offices throughout Austria and Hungary. These, on the strength of their past experiences, have refused to make the least concession in the premiums payable for the fire insurance of buildings lighted solely by electricity. Whatever security electric lighting may afford in the eyes of the electrician, it is not reflected in a diminished drain on the purse of the consumer who has been led to substitute electric light for gas on account of the alleged rtsk of fire with the latter.

If we look at the reports of fires elsewhere, we see the electric light continually given as the origin of the outbreak. Within two years, 2,000 fires in America were traced to electrical installations; and in the course of one half hour in 1895, the Vienna Fire Brigade was called to as many as four distinct houses where electricity had caused fires to break out. Taking this year only, already notable fires in Munich, Frankfort-on-the-Main, Berlin, Hamburg, Stockholm and Charlottenburg can be traced with certainty to electrical conductors or lamps. In Charlottenburg, indeed, electricity is little used; yet the list of fires attributed to short-circuiting is pretty extensive.

Such, briefly, are a few of the facts with regard to the relative riskiness of gas and electric lighting. They are not put forward with the object of disparaging the latter—for electricity has a sphere of undoubted usefulness as an illuminating agent—but rather to prevent guileless consumers believing the utterances of ill-informed or interested parties, who state glibly enough that the electric light removes the danger of fire when substituted for gas lighting in a building. Reliable statistics at present distinctly point to gas as the safest of all the illuminants in general use.

[Prepared for the JOURNAL.]

The Illumination of Inclosed Space.—No. II.—An Attempted Solution of the Special Case Described.

By DR. W. H. BIRCHMORE.

In the issue of this JOURNAL for November 29, 1897, I described in detail the illumination of a certain apartment of two rooms, stated as fully as seemed needful the defects found by examination, and gave the only clue which seemed to promise any definite results—the efficiency of the illuminating power of sunlight at various angles.

In the description of the rooms I omitted to mention the fact that they had no architectural significancy whatever, and that the doorway of communication between them was simply a hole in a wall bounded by a frame; the doors themselves were wanting.

Having made the studies as described in the previous contribution, it was determined to abolish the pendant lights, and give the rooms, to an extent at least, an artistic physiognomy. The values of the new lights, to take the place of the pendants, and their locations were determined before the other changes in the rooms were planned.

The first change made was to run an ornate cornice around the entire range of the walls, and to make of the square hole a more artistic opening. The bottom of this cornice (its lower edge) was made level with the top of the door opening into the hall, 7 feet 6 inches above the floor; the cornice was 1½ feet high, and the same in offset. The doorposts were enlarged in proportion. The communicating doorway was changed as follows: Where the partition came against the wall a finish pillar, like the doorpost, was set up, as if to support the cornice. Two pillars were set up, 10 feet centers, to form the door proper; and an arch was sprung between them, the keystone of which touched the ceiling. From these pillars to the finish posts and cornice, were sprung two lesser arches, the space above them being filled by a plaster finish piece.

The space above the cornice was finished as a mezzanine, in panels parted by finish posts. The panels contained decorative pieces in plaster. The height of this mezzanine was 3½ feet to the ceiling. The change in the number of the lights was not unimportant, although insignificant compared to the change in position and gain in efficiency.

In the front room between the two windows were placed two mantles, and on the sides six others, three on either side, dividing the wall into two panels of 10 feet each and the half panels; in all, eight lights instead of five, an increase of three. In each case the light was in the top of a finish post.

In the rear room substantially the same change was made. Two lights were placed between the rear windows, answering to those at the front, and, on either side two lights, making one 10-foot panel and two half panels; in all, six lights in place of four.

The paired lights between the windows were 2 feet center to center, and in all cases the light had a definite function in the architectural design. The total increase in the number of mantles was five; three in the front room, two in the rear.

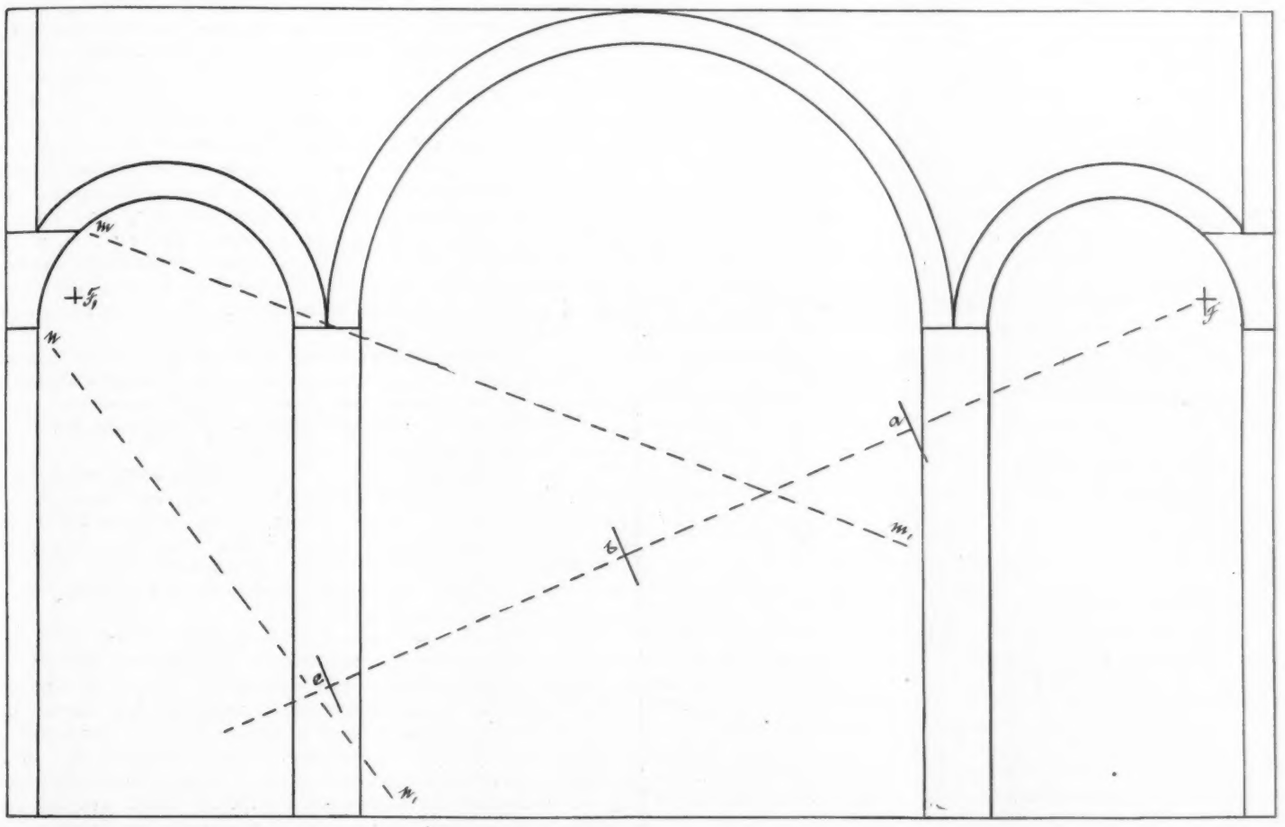
Assuming the actual rated candle power to have been the same as the normal, 40 candles to each mantle, there were, then, 320-candle power in the front room and 240 candle power in the rear room; 560-candle power in all, as against 360 candle power before the change was made.

This number of candle power represents 0.56 candle power for each square foot of floor space, or 0.32-candle power for each square foot of wall surface.

It is not quite fair to reckon in this way to the full height of the room, for a reason which will appear later, and if the height of the top of the cornice be taken as the superior plane the results will be better adapted for comparison; allowing for this, the lights were 0.45-candle power for each square foot of wall.

Up to this point the work had been purely the correction of a faulty design, giving the room a more interesting appearance, and giving a suitable place in the details of the architecture of the fixtures to hold the mantle lights. We had determined the lights should be placed on the sides, and where. Now we had remaining the harder part of the task, to give to the new fixtures their proper values, artistic and radiant.

Judging from information obtained by experiments made for the purpose, I determined to use no shades, but to let all the light radiating from the front half of the mantle travel in its unchecked way into the room, and to guide the other half by reflection into the path of my own choice. It was much more complex a task than I imagined, but by repeated failure I learned to direct the light into a path somewhere near right.



The fixture was so placed that the axis of the chimney came 15 inches from the wall, or 3 inches within the cornice line. This threw the mezzanine directly behind and above it into a full shadow, causing the illumination of this part of the wall above the cornice to be made entirely by the lights from the opposite side of the room, thus lighting the ceiling of the room much less than the floor.

The reflectors were, at the first trial, parts of spheres figured to bring the caustic surfaces into the axis of the room. This did the work intended; but experiment showed that artistically it was a complete fiasco, for whenever the eye encountered the caustic it saw an inverted image of the light.

I then tried part of a parabola, placing the parameter at an angle to the horizon. This gave no images; but the caustic surfaces were insufficient, so I split the difference and used a hyperbola as the the plane figure to generate the reflecting surface, by revolution, setting the transverse axis at the desired angle.

This gave a larger caustic surface than the spherical reflector, and made no images.

Having determined the osculating surface, it was next in order to break it into facets; for convenience of working, these were made 12 in number, and, starting with a radius of 3 inches, reached zero at the axis of the chimney. Of course the surface was perforated to let this pass.

Moulds were made from a clay model, and copper was planished to fit, nickel plated and burnished. From the method of working, the surface was not perfect, which added to the merit; that is, although the nickel made an almost ideal reflecting surface, the copper beneath it was not anywhere a "true surface." This produced certain beautiful phenomena of iridescence, probably from interference phenomena, and added variety which could never have been obtained by design.

When the reflectors were in place, and the mantles in full working order, the suggestion was a *shell* placed behind the mantle, as an ornamental detail, not of a reflector at all. So much for the device employed to accomplish the purpose.

It will be seen from the description that one-half the radiation went out into space uncontrolled. That is, all the light which would naturally fall on any surface in the room from thus placed lights fell there; at the same time the other half of the radiation, or rather about 90 per cent. of this half, was distributed over a space chosen in advance.

See JOURNAL, *ante*, p. 843.

This space had a vertical angle of 30°, and a horizon of not quite 120°. Within this space the amount of useful light was rather more than was hoped for. Taking the horizon of the cornice, it is evident that the space below received from the front of the mantle one-fourth of all the radiated light. The balance of the radiation from the front of the mantle was radiated partly upward and partly across the room to the wall above the cornice—the mezzanine finish previously described.

The rest of the light was diffused over the space of the room, as it were in a million small beams, at all sorts of angles of radiation and crossing, so that it appeared as homogeneous as any radiated light can —almost as daylight does, in fact.

To understand the law of this radiation the study of the diagram is suggested.

Description of Diagram.—Let this represent the conditions in the plane of the light next in front of the three arches connecting the two parts of the room. Let F and F_1 be the centers of radiation of the two Welsbach mantles. Let F, a, b, c be any radiation line of F's light; m m_1 and n n_1 are, approximately, the bounding rays of the light turned back by the reflector.

From the arrangements made, as has been stated, the hemisphere of radiation in front of F, for instance, radiates unmodified, the amounts of light falling on the plane a, b and c being governed only by the law of inverse squares, so far as F is concerned. It is obvious that any light which may reach these planes from the direct radiation will be modified by two laws; that of the inverse squares and that of the sines of the angles with the normal to the ray. It is also manifest that every plane which is parallel to the axis of the room will receive more or less light from every other light in the same side, and a very little calculation will show that, so far as the direct radiation is concerned, the part of the light which is controlled by the laws of the sines increases a little faster than the amount from any one center is diminished by the law of the inverse squares. Therefore, the plane a, in moving from a to c, with respect to F, may be said to receive light from the various other mantles on the same side, as follows:

(1) An amount from F, radiated directly, which diminishes by the law of inverse squares alone.

(2) An amount from all the other lights than F which diminishes according to the law of inverse squares, but at the same time increases with the cosine of the angle of incidence, or with the sine to the normal to the plane.

At a very large distance, the lights being so close to each other, the

difference in incidence angle would not be noticed, but at the distance equal to that between the centers of illumination it plays a very important part. For this reason the amount of light received from any one source on the same side between *b* and *c* is so little different from that received from any other one near it that the shadows of the first order may be said to be non-existent. That is, the condition exists which we find out of doors on an ordinarily bright day; if we do not go directly into the sunlight we find no shadow.

The reflector beam was made to follow a somewhat different law; the rate of diffusion was enforced in all planes, and in no two was it like. Considered with respect to the plane passed, as in the diagram, the entire reflected half of the radiation was delivered in one-sixth the angular space in which it started. Had the mirror been part of a circle of revolution instead of a hyperbola the reflected beam would have been a cone containing more or less nearly six times as much light as the direct beam (for convenience we might call the reflected light the indirect beam); but such indirect beam would have been sharply conical, and the edges of the caustic surfaces would have been rather too well defined; this has already been referred to. By using the hyperbola, however, the mirrors were rendered in a way astigmatic, and the rate of diffusion of the indirect beam, in a plane, parallel to *m* m_1, but having its axis in the plane of the wall, was as much greater in its angular value as the square of *m m* was greater than *n n*. In other words, if the linear relation between *n n* and *m m* was as 2:3, the diffusion, had the conical form of ray pencil been used, would be as 4:9, and nine light units would fall on *n* for every four falling at *m*. To avoid this the reflector was so spread out that in a plane perpendicular to the paper in the line *n n* these values would be reversed; and, consequently, each lamp (mantle) yielded the same amount of light to a square foot from its indirect ray at *m* as it did at *n*. Of course this adjustment of the valves held good only at these two points, but the adjustment was near enough to serve the purpose everywhere.

From this it follows that the overlapping of the indirect pencils must have been even more efficient in the equalizing of the illumination than the same artifice with respect to the direct pencils; and so the after inquiry into results showed.

Considered as a whole it may be said that within the middle two-fourths of the room the light front was practically a plane and that, so far as the side lights were concerned, the illumination was as smooth and even as if the lights had been only a few inches center to center and the number correspondingly increased. While there was a constant decrease between the sides and center, the relations of the factors in that decrease were those of a line, not of a point, and the reduplication of the light came where it was needed, not where it was not.

Considered with relation to its position between the walls a solid presented differences of illumination, but no contrasts. There were no contrasts; nowhere in the room could a place be found in which an intense light practically all in one direction would fall on a body with no opposite illumination. Differences of almost imperceptible value appear from study of the curves, but there is no place where these differences increase to such value as to disturb the form image. Shade, as distinguished from full light, is present everywhere; but shadow does not exist.

The part played by the lights at the two ends of the rooms is peculiar. They are small in comparison with the total illumination, and yet in their proper line of action they have a perceptible influence in producing the ultimate result. The angle at which the light of any other mantles hits a plane normal to this light is too small to make any great difference; but at the same time the change in direction counts. Differences in illumination due to the action of these lights may be seen nearly the whole of the distance from the wall to the middle of the rooms, and with tolerable certainty for about 20 feet, a result far more satisfactory than anyone could possibly expect, if the belief that disables effort because it anticipates failure had been allowed to control the plans of my friend the architect. To him rather than to me belongs the credit for the development of the scheme; I only did the work.

The Measure of Success.—How far were we justified in regarding our rather costly experiment as worth while; that is, from the standpoint of scientific demands? The client was quite willing to say "to any extent;" but I am not. We certainly got out of the light all there was in it. The direct beam at 10 feet from the mantle gave an efficiency of .4 of a candle at the unit distance. The indirect beam should have given 6 × .4 candles, but it gave only 4 × .4 = 1.6 candles; perhaps more nearly 1.5 candles. This was due to the loss by reflection and to the action of the enforced angle and the law of sines.

Still the total amount of light falling on any surface near the axis of the room and between any two of the mantles was not far from five times as much as would have fallen on any surface of the same dimensions, and at the same distance from the center of radiation, had the reflector been left out, and nearly one-fourth more than would have been given by the entire group of four lights at the same distance.

This reduced to its lowest terms is the same as stating that the efficiency of each light was increased from 4-10ths of a candle to nearly 2 candles, an increase amounting to about 5 times.

This gain is in increased efficiency alone, and belongs to the individual radiation center. The absolute disturbance at the center of the room from the side lights, the end ones being dark, amounts to the sum of the disturbances from each center individually; or, since the efficiency was increased by five, the total sum of all those was the same as it would have been at the same distance from ten pendants, each containing five mantles, hung in the middle. This brings into strong relief what the gain really was.

It is hard luck that no surface could be found of sufficient stability to take the place of the nickel, which needs almost weekly attention to retain its power of reflection, and yet is the best surface we have.

Something was also gained in another and unexpected place, in the sensible height of the room.

The eye accustomed to the brilliantly lighted ceiling and dimly lighted floor naturally regarded this as the natural order of things, and the instinctive decision was that the comparative dimness of the ceiling was due to the height, while it was really due to the distance and the shadow from the mezzanine cornice. A person perfectly familiar with the rooms, seeing them for the first time after the change, said, "I did not know that you had raised the ceiling."

I offer this as the record of an experiment, not as a belief in advocacy of an expedient. I do not think the result by any means ideal, nor by any means the best that can be gained, even with the defective means at our command. Certainly some to my mind palpable errors were made, but they seemed to be errors in the opinion of no one beside; certainly not to the owner of the house. Some of these I think I could remedy; some are absolutely in the nature of things and beyond human aid. Were I to have another chance I certainly should seek to avoid a tendency towards definite interference areas producing ghosts in the lines of light from the reflectors. If this account of my attempt shall be a useful item in developing the study of internal illumination I shall be satisfied.

[Concluded from page 892.]

A Comparison of Various Rapid Methods for Determining Carbon Dioxide and Carbon Monoxide.

By L. M. Dennis and C. G. Edgar.[1]

Determination of Carbon Monoxide.—The gas mixture to be analyzed consisted of a mixture of nitrogen and carbon monoxide, the latter being prepared from oxalic acid. Mixtures containing by measurement 3, 9 and 15 per cent. of carbon monoxide were used. The gas was absorbed by means of a hydrochloric acid solution of cuprous chloride. For preparing this solution of cuprous chloride, we have used for some years in this laboratory the method which was suggested by Sandmeyer,[2] and which has been found superior to any other that we have tried.

The methods for determining carbon monoxide which were compared were those of Orsat, Elliot and Hempel. After absorption by the cuprous chloride, the gas residue was always treated with potassium hydroxide, to free it from any acid vapors, before the final reading was made.

Orsat's Apparatus.—The gas sample was passed into the cuprous chloride tube and allowed to remain there for three minutes. It was then run back and forth from the burette for two minutes longer. Then it was passed into the potassium hydroxide tube and finally brought into the burette and measured.

Sample No.	Carbon Monoxide. Per Cent.	Results with Orsat's Apparatus. Per Cent.	Time in Minutes.
I	3	2.3	13:00
		2.5	12:10
		2.2	11:00
		2.1	13:00
II	3	2.0	12:10
		2.3	11:50
		2.7	12:30
		2.4	11:15

1. *Jour. Am. Chem. Society.*

2. Sandmeyer: *Ber. d. Chem. Ges.*, 17, 1633. Twenty-five parts of crystallized copper sulphate and twelve parts of dry sodium chloride are placed in fifty parts of water and heated until the copper sulphate dissolves. (Some sodium sulphate may separate out.) One hundred parts of concentrated hydrochloric acid and thirteen parts of copper turnings are then added and the whole is boiled in a flask until decolorized. Platinum foil will hasten the process. The solution is kept in glass-stoppered bottles until wanted.

III	9	8.4	14:00
		8.5	10:10
		8.4	10:30
		8.6	10:00
IV	9	8.5	15:40
		8.4	11:00
		8.5	10:30
		8.7	10:45
V	15	14.5	14:00
		14.2	15:00
		14.4	13:50
		14.6	14:10
VI	15	14.7	16:10
		14.3	15:40
		14.6	14:00
		14.4	15:15

Averages with Orsat's apparatus—

3 per cent.	2.31 per cent.
9 "	8.5 "
15 "	14.4 "

Elliot's Apparatus.—The gas was here also treated with potassium hydroxide after the absorption of the carbon monoxide.

Sample No.	Carbon Monoxide. Per Cent.	Results with Elliot's Apparatus. Per Cent.	Time in Minutes.
VII	3	2.4	10:00
		2.3	10:30
		2.4	9:50
		2.1	10:10
VIII	3	2.5	10:10
		2.3	11:00
		2.4	10:50
		2.0	10:30
IX	9	8.4	11:00
		8.5	10:50
		8.3	11:40
		8.0	10:20
X	9	8.4	13:00
		8.0	12:10
		7.9	11:50
		8.3	10:00
XI	15	14.1	14:10
		13.9	15:00
		14.0	13:50
		14.4	14:30
XII	15	14.0	14:00
		14.4	13:10
		13.8	13:40
		14.2	14:10

Averages with Elliot's apparatus—

3 per cent.	2.3 per cent.
9 "	8.2 "
15 "	14.1 "

Hempel's Apparatus.—Two double gas pipettes were employed, the one which was used second containing a fresh solution of cuprous chloride.[1] The gas was passed into the first pipette, which was then shaken for two minutes; then into the second pipette and shaken for three minutes; then into a potassium hydroxide pipette, and finally into the burette, where it was measured.

Sample No.	Carbon Monoxide. Per Cent.	Results with Hempel's Apparatus. Per Cent.	Time in Minutes.
XIII	3	3.2	10:10
		3.0	9:50
		2.9	10:00
		2.8	9:40
XIV	3	2.8	10:00
		3.0	9:50
		2.9	9:30
		2.8	9:20
XV	9	8.7	9:30
		8.8	9:10
		8.9	9:15
		8.8	9:30
XVI	9	8.8	9:10
		9.0	8:50
		8.9	9:00
		8.7	8:45
XVII	15	14.7	9:00
		14.6	8:40
		14.8	8:50
XVIII	15	14.5	9:00
		14.7	8:30
		14.8	9:00

Averages with Hempel's apparatus—

3 per cent.	2.9 per cent.
9 "	8.85 "
15 "	14.77 "

1. Hempel: Methods of Gas Analysis, p. 161.

The above results show that in the determination of carbon dioxide all of the five methods tested are accurate to within less than 1 per cent., and all except Honigmann's to within ½ of 1 per cent., provided the amount of carbon dioxide present does not exceed 30 per cent. The most exact results in every case, however, are those obtained with Hempel's apparatus, and when the carbon dioxide is as high as 40 per cent. this is the only method in which the error does not exceed .5 per cent. As regards speed, the Hempel method, with only 30 seconds allowed for the running down of the water, seems to have been the shortest, but was closely followed by the Honigmann method. Attention may also be called to the fact that while in the methods of Honigmann, Orsat and Hempel the same potassium hydroxide is used repeatedly, in the Bunte and Elliot methods the reagent cannot be used twice, these methods being thus extremely wasteful.

In the determination of carbon monoxide the superiority of the Hempel method, both in accuracy and speed, is even more marked. Better results than those cited can be obtained with both the Orsat and Elliot apparatus, but only by greatly prolonging the time.

Reduction in Cost of Steam Power from 1870 to 1897.

[A paper by Mr. F. W. Dean, Boston, Mass., before the American Society of Mechanical Engineers.]

In the year 1870 the most economical steam engine in use in mills was the Corliss simple condensing engine, which used 19 or 20 pounds of steam per horse power per hour. Previous to that time compound engines had been used in England in mill practice, and simple engines had in many cases been changed to compound. In this country compound pumping engines had been used to a very limited extent, notably the Worthington direct acting duplex compound, the first one of which was put in at the Charlestown, Mass., water works in 1863, and the installation of the Morris engine at Lowell and the Leavitt engine at Lynn are well-known examples of them in the early part of the period which we are considering. The Lowell engine was of the Simpson type, so named from the Simpsons of London, who originated the arrangement of two compound cylinders with different lengths of stroke under one end of a beam. It is known as the Morris engine from Henry G. Morris, the builder, but its design is due to the late Robert Briggs of Philadelphia. The Pawtucket pumping engine, built by George H. Corliss, and started on June 30, 1878, is another important example of economical pumping engines, and probably was the most economical steam engine which had been built up to that time, having used less than 14 poundsof dry steam per indicated horse power per hour. While these engines are not mill engines, they influenced the practice of builders of mill engines, and can properly be considered with them. Pumping engines have heretofore been the leaders in economy, but at present the best pumping and mill engines are practically equally economical.

Of course the greatest single step in economy was the introduction of the compound engine. At the present time we may cite the Louisville pumping engine and several mill engines, one or more at Grosvenor Dale, Conn.; Natick, R. I.; West Boylston, Mass.; Berkley, R. I., and Lawrence, Mass., as being about on a par, and representing the best commercial economy. In 1873 the most economical compound engines used about 16½ pounds of steam per indicated horse power per hour, as shown by tests of the Lynn and Lawrence pumping engines, which then established new records for duty. Improvements in methods of using steam were made, until it is now as easy to design an engine to use less than 13 pounds of feed water per horse power per hour as it was to use as little as 16 pounds in 1875. At this date steam jackets were common, and were used in all engines which gave the most economical performances. The steps, however, that lowered the steam consumption of compound engines from 16 to 14 pounds per indicated horse power per hour were largely the introduction of a cut-off on the low pressure cylinder and a reheating receiver between the cylinders. Although the reheater was invented by the late E. A. Cowper of London, in 1862, so far as I know it was first used in this country by E. D. Leavitt in his engines for the Calumet & Hecla Mining Company, and is regarded by him as one of the most important causes of the economy of his engines.

These features appear to have been the principal means of lowering economy to 14 pounds of steam; but to what are we to attribute the step to 13 pounds? Clearance is well-known to be an important factor, and its reduction, especially in the last cylinder of a series, is important for economy. It is receiving constant attention from careful designers, and its reduction is a constant source of gain. The

13-pound mark has also been reached by an increase in steam pressure with resulting increase in the number of expansions. In some cases a reduction in the size of the high pressure cylinder has doubtless contributed toward economy, by means of which smaller surfaces are exposed to the boiler steam than would otherwise be the case. This carries with it a proportional reduction of initial condensation in the cylinder which is most prolific in this cause of waste. Still further, the 13 pound mark has, in general, been attained by engines which have a low pressure cylinder larger for the work to be done than is commonly the case, so that the mean effective pressure referred to the low pressure cylinder is in the vicinity of 21 pounds. There are occasional exceptions, as in the case of the Louisville engine, which worked with a mean effective pressure referred to the low pressure cylinder of 25 pounds. Such cases are exceptional, and their economy can be attributed to great perfection of detail.

It will in general be observed, however, whatever may be said of other causes, that most of the extreme cases of economy are those in which a good vacuum has been maintained. This leads me to say that the importance of good vacuums is often not appreciated, and that air pumps and condensers are as often too small.

There is a strong tendency nowadays to underrate steam jackets, but I believe that in every case where they have been wasteful, or where their economy is indifferent, at all events with ordinary speeds, an examination would show that the jackets are air bound, water logged, blowing through traps, or that the jacket piping is bare, and thus steam for heating the building is charged to the engine. Such an arrangement of pipes can furnish but indifferent material for giving up latent heat to the working fluid within the cylinders, and is, in fact, absurd.

The effect of reheaters in drying out steam which issues from a preceding cylinder and in superheating it to 60 or 90 degrees, as is often the case, for use in the next cylinder, cannot be otherwise than advantageous, for, as Professor Thurston shows in his paper of 1894 before this society, heat so added to the working fluid saves much more steam than was condensed to liberate this heat. While these considerations are very general, they are necessarily so, for nobody can attribute to any one of the features named its proper effect. Moreover, their combinations are very varied. Whatever may be said pro and con on this subject, it cannot be denied that the best results have been obtained from engines equipped with jackets and reheaters.

Considering economies effected, it is safe to say that without including triple expansion engines steam economy has steadily decreased from 20 to 12½ pounds per indicated horse power between 1870 and 1897. This corresponds to a saving of 37½ per cent.

Within this period of 27 years the use of exhaust steam has extended in various mills, such as cotton, woolen and paper mills, so that in some mills the cost of steam power is next to nothing. Economies of this kind are not confined to the use of the exhaust of non-condensing engines, for since 1895 the writer's firm have had installed at the Washington Mills, Lawrence, Mass., a large surface condensing vertical compound engine, the rejected heat of which is utilized. In this mill large quantities of warm water are used in the dyehouse, which has heretofore been heated by exhaust and direct steam. Now the circulating water of the new engine is sent from the condenser to the dyehouse by the circulating pump at about the temperature required. In this case the rejected heat of the engine is just as effectively used up as it would be if the engine were non-condensing and sending its exhaust to the dyehouse. There are advantages, moreover, in the compound surface condensing engine, for there is less rejected heat to use, with consequent diminished chance for waste, and there is less heat lost by radiation from a pipe full of warm water than from one full of steam. This constitutes one of the latest forms of recent economies. It may be mentioned incidentally that by the surface condensing engine oil is kept out of the dyehouse and away from the cloth. The air pump discharge being small in volume, and containing all of the cylinder oil, can be easily taken care of in any way which appears to be advantageous.

What is there to be said concerning boilers within the period that we are considering? The horizontal return tubular boiler is still the standard of the country, and will probably so remain. It is cheap, and if properly built it is safe. As its tube heating surface can be effectively blown with steam with the certainty that the jet will strike every part thereof, and as, furthermore, its tubes can be effectively scraped at any time without taking the boiler out of service, it must necessarily be more economical than any of the numerous water tube boilers which are now being introduced. The fire surfaces of the latter can only be indifferently blown, and they cannot be scraped at all unless the boiler is cooled down, and in general it cannot then be done with anything approaching thoroughness. There is scarcely any improvement to be noted in the horizontal return tubular boiler during the last 27 years as far as economy is concerned, but I believe that grates have been improved to a measurable extent, resulting in an economy of perhaps 2 per cent. My own experience teaches me that the internally fired boiler, either of the locomotive or vertical type, will save under equal conditions some 7 per cent. of coal compared with the horizontal return tubular boiler, besides causing an important economy in doing away with brickwork.

Bryan Donkin, in a recent paper before the Institution of Civil Engineers, in discussing boiler economies says: "Generally speaking, internally fired boilers give a higher efficiency than those externally fired. The old and well-known locomotive type, with smoke tubes and induced draft, stands high as a very economical steam generator." Such praise from so careful an investigator as Mr. Donkin should carry great weight.

Within 27 years economizers for heating feed water in smoke flues have become common. Although subject to a rather large depreciation, in the general case they will save about 7 or 8 per cent. of coal.

There are economies to be obtained from the use of vertical engines. These come from reduction of friction, reduction of repairs to cylinders and pistons, and diminished cylinder oil consumption. It would not surprise me if there were a net saving of 5 per cent. by reduced friction of a vertical compound compared with a horizontal engine.

Summing up the various items that have been mentioned, the following may be presented as the economies of the period from 1870 to 1897:

	Per Cent.
Saving due to compounding, jackets, reheaters, higher pressures and greater expansions	37
Due to vertical engines	5
Due to vertical internally fired boilers	7
Due to economizers	7
Due to improved grates	2

As these economies could not be simultaneously applied to the original condition of a mill, their sum is not a result that could have been realized in any case. With these important economies having been brought about during 27 years, the question arises, Are there any compensating disadvantages?

It is easy to show that there not, for—

1. The first cost of a cross compound condensing engine is no greater than that of a pair of simple condensing engines 27 years ago, on account of improved tools and processes and reduced prices of materials.

2. Interest charges are less than they were 27 years ago.

3. The depreciation of engines is less than it was 27 years ago, on account of better materials, better workmanship, better oil, and better means of applying oil. Vertical engines will render the depreciation of cylinders, pistons, piston rods, piston rod packing and cross heads less than similar parts in horizontal engines.

4. The reduction in the number of boilers required by some 33 per cent. for a given power within 27 years carries with it many reduced charges, such as first cost, interest, repairs, depreciation, insurance, taxes, cost of boiler houses, cost of attendance, and various lesser items.

5. Present boiler building practice is superior to the old, so that high pressures are now as safely and comfortably carried as the lower pressures of 1870. Better materials, longer plates and fewer joints, butt joints of high efficiency and maintaining the circular form with changes in pressure, drilled holes, hydraulic riveting and round tool calking render it as safe to carry 200 pounds or more as any lower pressure.

6. I might include reductions in cost due to handling coal by conveyers for large plants and by mechanical stokers. Conveyers are in some cases very economical, but mechanical stokers are of doubtful value, speaking generally. The greatest efficiency of the conveyer is to be found in connection with the mechanical stoker.

So far the only steam engine considered is the compound engine. This engine has recently been found capable of utilizing the higher pressures much more economically than was formerly suspected. It has therefore diminished the advantage of the triple expansion engine to such an extent that the latter has met with something of a setback. I believe, however, that the triple engine is still to be common when pressures begin to exceed 160 pounds of steam, and its undoubted advantage at sea gives evidence that it will be no less on land. Within a year or two an interesting and instructive comparison can be made between two pumping engines, one compound and one triple, both to use 185 pounds of steam and designed on the same lines by Mr. Leavitt. It

seems probable that the relative economies of the compound engine, using 160 pounds, and the triple, using 185 pounds of steam, are to-day represented in the very best practice by 12¼ pounds of steam and 11¼ pounds of steam respectively per indicated horse power per hour. This corresponds to a saving of 8.16 per cent., which is a paying saving.

Very careful attention should be paid to the kind of steam valves used in engine cylinders, for leaky valves can readily nullify the advantage which may be derived by anything which can be done to contribute to economy in the general design. It is the writer's experience that the gridiron valve, properly designed with ample lap, and originally made strictly tight by scraping, will remain so far longer than any other kind.

The future, so far as we can now see, offers us highly superheated steam for further means of economy. The technical papers have frequent accounts of the use of such steam in Germany, and published tests (see *Engineering*, pp. 113, 391, 1895) show that a small Schmidt "motor" has used 10.17 pounds of steam per indicated horse power per hour. It would seem that we have a right to anticipate in the early future a steam rate of 10 pounds by means of superheated steam in the best designed engines. Compared with the lowest rate thus far mentioned, this corresponds to a saving of 11.11 per cent.

We have also in anticipation the use of very high steam pressure and quadruple expansion engines as built experimentally at Cornell University and described by Professor Thurston last year before this society. If, however, steam can be so highly superheated that expansion in one cylinder will not cause condensation or even the saturated condition until the time of exhaust, as was the case in the Schmidt motor, extreme economy may be obtained without resort to the multiple expansion engine.

The economies thus far mentioned relate to improvements in engines and boilers; but one of the greatest economies results from the low cost of coal at present in Lowell, Lawrence and similarly located towns.

The prices of coal in these places every five years were as follows:

Year.	Price.	Kind of Coal.
1870	$7.10	Anthracite.
1875	7.20	Anthracite.
1880	4.75	Bituminous.
1885	4.25	Bituminous.
1890	4.65	Bituminous.
1895	3.85	Bituminous.

These prices show a saving from 1870 to 1895 by themselves of about 46 per cent.

I shall now consider the actual figures making up the cost of a mill steam plant, and its cost of operating, say of 1,000-horse power, in most mill towns in the State of Massachusetts away from tidewater. The very best steam plant of this power 27 years ago, including a pair of simple condensing engines using 20 pounds of steam, boilers evaporating 8 pounds of water on total coal used, buildings, chimney, and all accessories, cost $70 an indicated horse power. The fixed charges on such a plant were interest at 6 per cent., depreciation at 4 per cent., repairs at 2 per cent., insurance at 1 per cent., or a total of 13 per cent.

13 per cent. of $70 is	$9.10
Coal at 2.50 pounds per I.H.P. per hour, at $7.10 a ton	24.40
Attendance, boilers—3 day men at $1.50, 1 night man at $1.50	1.85
Attendance, engine—1 engineer at $3, 1 assistant at $2	1.54
Oil, waste and supplies	1.25
	$38.14

The very best plant of 1,000-horse power can be installed to-day complete, including buildings, chimney, compound engine using 12.5 pounds of steam, boilers evaporating 9 pounds of water on total coal used, economizers and all accessories for $57 per indicated horse power. Such a plant can run on 1.4 pounds of coal per indicated horse power per hour for total coal consumed. The fixed charges are: Interest at 5 per cent.; average depreciation, 3½ per cent.; repairs, 2 per cent.; insurance and tax, 1 per cent., or a total of 11½ per cent.

11½ per cent. of $57 is	$6.55
Coal at 1.4 pounds per I.H.P. per hour at $3.85 a ton	7.41
Attendance, boilers—2 day men at $1.50, 1 night man at $1.50	1.39
Attendance, engine—1 engineer at $3.50, 1 assistant at $2	1.69
Oil, waste and supplies	.80
	$17.84
Saving in 27 years in first cost, per cent	18.6
Saving in 27 years in operation, per cent	.53

On the supposition that superheated steam can reduce the steam consumption to 10 pounds per indicated horse power per hour, and that the combined efficiency of boilers and economizers is not affected thereby, the cost of instaliation of 1-horse power can still be taken at $57.

The cost of coal per I.H.P. will be	$5.88
Other charges will be	10.43
Total	$16.31

This makes a saving of yearly charges, compared with the best present plant, of 8½ per cent.

Some actual costs of a yarn mill in Massachusetts, built in 1889, are as follows:

Cost per horse power of engine (compound)	$60.50
Total coal burnt per year, tons	2,674
Average indicated horse power for the year	1,132
Total coal burnt for power, heating mill and banking fires, per indicated horse power per hour, pounds	1.75
During the six months when no heating was done, the coal used per indicated horse power per hour was, pounds	1.65

The cost of operating a horse power per year was as follows, assuming 11½ per cent. fixed charges:

Total cost of plant, $66,600, at 11½ per cent.	$7,659.00
Coal, 2,674 tons, at $4.75 per ton	12,701.00
Attendance, $8 85 a day × 308 days	2,725.80
Oil waste and supplies	312.00
Total cost of power	$23,397.80
Average horse power per year, I.H.P.	1,132
Cost per I.H.P. per year	$20.67
Cost corrected for coal used in heating mill	20.01

The following figures were given in the *Engineering Record* for March 14, 1896, for the Stevens linen mill, Webster, Mass. The engine is a compound, and was indicated morning and afternoon every working day throughout the year, and the coal is that used for all purposes throughout the year:

	1893.	1894.	1695.
Average indicated horse power for the year	381	393	396
H.P. hours for the year	1,042,221	893,792	1,076,134
Coal, pounds for the year	1,831,700	1,493,243	1,775,720
Average coal per indicated horse power per hour, pounds	1.76	1.67	1.65

In order to place them in the pages of the Transactions of the Society, and as illustrating a recent steam engine performance, I add the results of two trials of a high class steam engine built within the last year. Considering the steam pressure used, it is the best performance of which I know.

The engine is at the mills of the Atlantic Cotton Mills, Lawrence, Mass., and the trials were made on February 17 and 18, 1897, by the writer. The engine was built by the McIntosh & Seymour Engine Company, of Auburn, N.Y., and is a vertical cross compound having its shaft a part of the water wheel shaft. It is provided with gridiron inlet and exhaust valves on both cylinders, and auxiliary cut off valves of the same kind on both cylinders. The valves have positive motions throughout, and the points of cut off are determined on both cylinders by a shaft governor. The high pressure cylinder is jacketed throughout by steam of boiler pressure, and there are reheating coils in the receiver, through which live steam of boiler pressure circulates. The low pressure cylinder is unjacketed. During both tests the condensations from the jacket and reheater were weighed together on platform scales, the amounts of which are stated below. The temperature of the condensation was determined some 30 feet from the reheater. The boilers supplied steam to nothing but the engine. A feed water heater was placed in the low pressure exhaust pipe near the low pressure cylinder, and the temperatures of the water, as it entered and left, were taken for the purpose of the information gained thereby, although it had no relation to the contract for the engine. For the same reason the jacket and reheater condensations were determined. The feed water was weighed on accurate scales by an experienced man. The indicator springs were tested under steam on the Government apparatus at the Brooklyn Navy Yard. The engine was taken in its every day working condition, and the results are, so far as I can see, being duplicated in regular operation. After the trial the diameters of the cylinders, while hot, were measured and the lengths of the strokes determined.

In the table it will be noticed that the temperature of the injection and feed waters is stated as 32° F. While this is unusually low, it was determined by five different high grade thermometers, all of which gave the same result. As the water in the river and canal, from which these waters came, was covered with ice, its temperature must have

been almost exactly 32°. The following are the leading dimensions of the engine and the results:

Dimensions of the Engine.

Diameter of the high pressure cylinder, inches	24.031
Diameter of the low pressure cylinder, inches	48.031
Diameter of the high pressure piston rod, inches	5.00
Diameter of the low pressure piston rod, inches	5.00
Ratio of piston areas	4 to 1
Stroke of each piston, inches	48.00
Revolutions per minute, about	100
Piston speed per minute, about	800 feet

Results of Trials.	1st Trial.	2d Trial.
1. Duration, hours	5.079	5.583
2. Number of revolutions per minute	100.704	99.633
Average Temperatures.		
3. Of external air, degrees	37	42
4. Of engine room, degrees	65	65
5. Of steam near high pressure cylinder, degrees	359	371
6. Of steam near low pressure cylinder, degrees	312	309
7. Of jacket and reheater drain, degrees	342	341
8. Of injection water, degrees	32	32
9. Of condenser discharge, degrees	56	66
10. Of feed water before entering heater, degrees	32	32
11. Of feed water after leaving heater, degrees	94	101
Average Pressures.		
12. Of atmosphere by barometer, pounds	14.67	14.62
13. Of steam at engine by gauge, pounds	123.00	123.00
14. Of steam at engine, absolute, pounds	137.67	137.62
15. Of initial in the low pressure cylinder above atmosphere from indicator diagrams, pounds	10.00	14.50
16. Of initial in the low pressure cylinder absolute from indicator diagrams, pounds	24.67	29.12
17. Vacuum by test gauge, inches	28.00	27.10
18. Mean effective pressure in high pressure cylinder, pounds	33.69	43.92
19. Mean effective pressure in low pressure cylinder, pounds	11.19	13.91
20. Mean effective pressure reduced to low pressure cylinder, pounds	19.61	24.89
Superheat.		
21. Superheat near high pressure cylinder, degrees	7.5	20
22. Superheat near low pressure cylinder, degrees	74	61
Powers.		
23. Power developed by high pressure cylinder, horse power	365.2	470.6
24. Power developed by low pressure cylinder, horse power	492.9	605.8
25. Total horse power	858.1	1,076.4
26. Per cent. of power developed by high pressure cylinder	42.5	43.7
27. Per cent. of power developed by low pressure cylinder	57.5	56.3
Steam Used by the Engine.		
28. Total weight used by engine, jacket and reheater, pounds	56,271	76,662
29. Total weight used by engine, jacket and reheater per hour, pounds	11,167	13,731
30. Total weight used by jacket and reheater, pounds	5,881	7,475
31. Total weight used by jacket and reheater per hour, pounds	1,158	1,339
32. Per cent. of jacket and reheater steam to total used	10.4	9 8
33. Actual weight of total sum used per I.H.P. per hour, pounds	13.01	12.76
34. Actual weight of total steam used per I.H.P. per hour, corrected for superheat, pounds	13.05	12.87

The results on the two days furnish some interesting data in relation to the falling off in economy of a compound engine when it is underloaded. Taking the results of the second test as a standard, the load on the first day is 20 per cent. less, while the steam consumption is but slightly over 1 per cent. more.

Saving by the Feed Water Heater.—The average increase in feed water temperature caused by the heater for the two days is 65½°, which, under the present conditions of temperature and steam pressure, is equivalent to a saving in coal of 5.6 per cent.

The following table gives the rate of heat transfer from the steam to the water:

	First Trial.	Second Trial.
Temperature of water before entering heater, degrees	32	32
Temperature of water after leaving heater, degrees	94	101
Increase in temperature of water, degrees	62	69
Average temperature of water in heater degrees	63	66.5
Absolute pressure in low pressure exhaust pipe, pounds	0.87	1.36
Corresponding temperatures exhaust pipe, degrees	99	111
Average difference of temperature between steam and water, degrees	36	44.5
Feed water used per hour, pounds	11,167	13,731
Heating surface of heater in contact with steam, square feet	234	234
Amount of heat transferred per hour, B.T.U.	692,354	947,439
Heat transferred per degree of average difference in temperature per square foot of heating surface per hour, B.T.U.	82	91

The Mitchell and Harleman Gas Producer.

On November 30th, 1897, United States Letters Patent (No. 594,483) were granted to Messrs. K. M. Mitchell, of St. Joseph, Mo., and John Harleman, of Kansas City, Mo., for certain "new and useful improvements in fuel gas producing apparatus." Using the words of the specification:

Our invention relates to that class of apparatus for producing gas from fuel, such as coal or coke; and our present invention is adapted for using bituminous coal as the main fuel after starting the fire with coke.

The novel features of our invention will be made to appear from the following description and claims.

In the accompanying drawings, Figure 1 represents a vertical central section of the apparatus in the line 2 2 of Fig. 2; Fig. 2, a similar section in the line 1 1 of Fig. 1, and Fig. 3 a cross section in the line 3 3 of Fig. 1.

A indicates the sheet iron cylinder or outer shell, and *B* the brick lining within the same.

C is the fireclay retort, oval shaped in cross section and tapering toward its top. It is made with its wall imperforate, and with longitudinal grooves or channels *c' c'*, etc., on its interior, constituting a continuous series of uninterrupted corrugations extending to the rounded-off top, as shown. The oval form of the retort, while allowing it at the broadest part or diameter of its lower end to rest upon inward projections of the circular brick wall, which is between it and the outer brick lining *B*, allows ample free space between its narrower part or smaller diameter for the upward passage around the exterior of the retort to the short fireclay lined pipe *L* on its way to the superheater.

D is the grate; *E*, a hopper at the top for feeding in the fuel.

F F' F' are the cleaning and shaking up doors, and *G* the ashpit.

H is a superheater at one side of and in direct connection with the above named heating apparatus, by means of a short large gas pipe *L*, named below.

I is a steam jet blower connecting the upper part of the superheater with the space or ashpit beneath the furnace grate.

J is an air inlet valve for the superheater, and *K* its gas outlet.

L is the gas pipe connecting the superheater with the space *c'* surrounding the retort *C*.

M is a vertical annular flue in the brick lining for carbon gas from the retort, and *N* is a flue leading from the top of the retort to this annular flue *M*.

The upper doors *F'* not only serve to allow the shaking up of the fuel, but the passages leading inward from them through the brick lining *B* also serve as a conduit or flue from or to the annular gas flue *M*, as indicated by arrows in Fig. 1.

The doorway into the furnace and ashpit for clinkering is shown at *P*.

Q are dead plates serving to support the ends of the grate bars.

R R, etc., indicate block tilings or lateral supports for the retort, and their ends rest on rings or projections *r'*.

S S, etc., represent sight holes through which to ascertain the depth of fuel in the retort, and they are provided with suitable caps *s'*.

T T, etc., are the vertical tubes in the superheater shell *H*. A hot air pipe *U*, extending downward from the top of the superheater, connects with the steam jet blower *I*.

V is a cleaning hole in the base of the superheater, and *X* is a brick support for this superheater.

Y is the coke chamber or furnace, located just above the grate and between it and the bottom of the retort *C*.

Z is a valve for turning on steam to the blower *I*. This valve also draws in air through the superheater *H*, and its steam is supplied by a steam pipe *z'*, which may derive its steam from any convenient source.

It will be observed that by our process and mechanism the hot air and steam are mixed at the point of entering into the furnace by means of the steam jet exhauster or blower.

The object of corrugating or grooving the retort, as described, is to allow the gas from the coal as it is generated to pass downward or upward, if it happens, in the descent of the fuel in the retort, that the

Fig. 1.

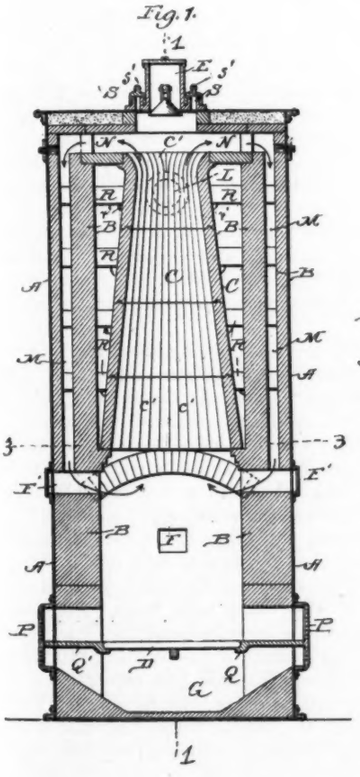
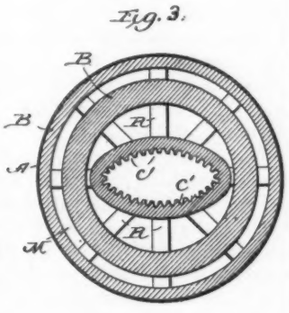


Fig. 3.



lower part of the fuel in this retort is obstructed, the gases will pass off at the top and then pass down around the annular space into the hot gases from the incandescent fuel and the tar be made into gas. This annular space around the gas machine is for the purpose of conveying the carbon gas, rich in tar and hydrocarbons, and also for the purpose of further carburizing and fixing these oils and tars.

The tilings *R*, while holding in place and supporting the vertical retort, yet afford a free continuous opening for the passage of the hot gases. The retort, being open at its top and connected by means of annular flues or passageways for the outlet of gas, it is thus brought down through the hot chamber into the hot gases below.

The operation of the apparatus is as follows, viz.: In starting, coke is filled in on the grate *D*, filling the chamber *Y* up to the bottom of the retort *C*. Bituminous coal is then gradually fed into the retort. Steam is turned on to the blower by means of valve *z*, which then draws in air through the superheater. The steam and heated air passing up through the coke produce a gas. The hot resultant gases partly pass up around the exterior of the retort and partly through between the corrugations in the channels *c'* and the fuel. The gas exit is at the top, where it passes through a fireclay lined pipe *L*, to the superheater *H*, where the heat of the gas is partly given up to the ingoing air to support combustion. The carbon gas that is produced in the retort is made to pass down either through the corrugations or around the annular space *M* into the hot gases from the incandescent coke on the grate. The object of bringing the carbon gas to mix with the hot gas is to heat and convert the tar into gas, thereby giving a more valuable fuel and getting rid of a very objectionable quantity of tar in the mains and valves, which in a short time would clog up and render the machine inoperative.

Superheating the air for producing gas allows of a larger quantity of steam to be used before the fire is cooled down, thus giving a larger quantity of gas.

The cleaning or shaking-up doors are for the purpose of occasional breaking of the coked coal into smaller lumps and evenning up the fire. The claims of the inventors are :

1. In a gas producer, the combination of a furnace, a retort tapering upward and having its wall imperforate and grooved vertically on its inner surface, and having an annular space or chamber as described surrounding such retort, and an annular flue surrounding such chamber and in communication at its top with the retort and at its bottom with the coke chamber located between the grate and the bottom of the retort.

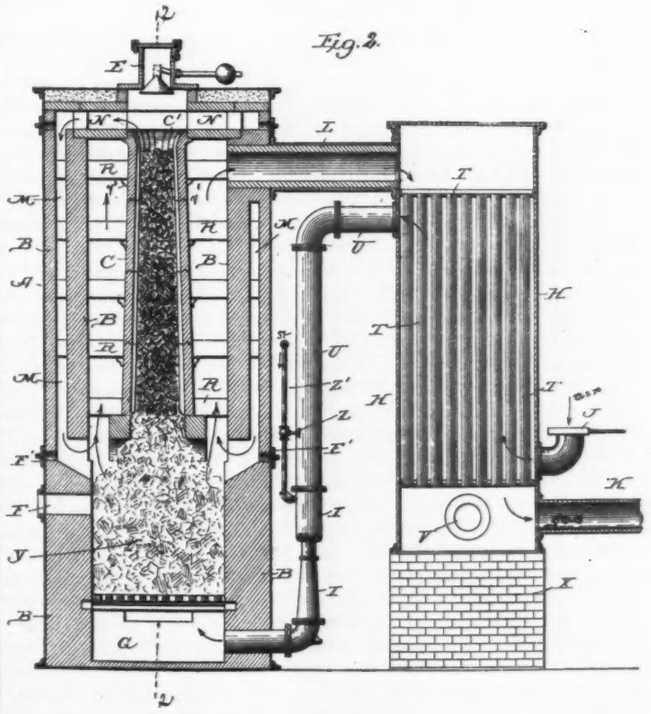
2. In combination, the furnace, the tapering imperforate and grooved retort, the annular space or chamber having at its upper end a gas exit pipe, the annular flue *M*, the superheater, a hot air pipe and blower, said pipe connecting the superheater at its top with the space beneath the furnace grate, and a valved steam pipe communicating with the blower, all substantially as and for the purposes set forth.

3. In a gas producer, the combination with the furnace of a retort oval in its cross section, and having a solid imperforate wall grooved vertically as described on its interior surface, thus affording passages for the gas as generated, to pass either upward or downward in such grooves, but not laterally through the wall of the retort.

4. In combination with the furnace, the vertical, tapering, imperforate retort grooved on its interior as described, and provided with exterior rings or projections, and block tilings or lateral supports resting at their inner ends on such rings or projections, all substantially as set forth.

5. In a gas producer, the combination of a retort having an imperfo-

Fig. 2.



rate wall oval in cross section, open at its top and internally grooved as set forth, an annular flue or passage around the retort and in direct communication with its top and with the coke chamber located between the grate and the bottom of the retort, and also in communication with the space surrounding the retort and between it and said flue, the combination serving not only to permit the hot gases as generated to pass upward or downward in the retort grooves, but also to pass upward around the exterior of the retort, all substantially as set forth.

6. In combination, the tapering, oval and internally grooved retort *C*, the flue *N*, leading from the top of this retort, the annular flue *M*, leading down from the flue *N* to the bottom of the retort, and the chamber directly surrounding this retort and between it and flue *M*, and pipe *L* connecting the upper part of said chamber with the superheater, all substantially as set forth.

7. The furnace and its tapering grooved retort, in combination with the flue *N*, leading from its top, the flue *M*, leading down from *N* to the bottom of the retort, the chamber directly surrounding the retort, the gas pipe *L*, the superheater connected by this pipe with such chamber, the hot air pipe *U*, connecting the superheater with a steam jet and leading to the space beneath the grate, all substantially as and for the purposes set forth.

The Brick Industry of Fletton, England.

In an article descriptive of the "truly ancient brick industry" of Fletton, England, *The Builder* (London) says:

Travelling from London to Peterborough by the Great Northern Railway, just before arriving at the latter station the line passes through an area which is covered with brickworks, the tall chimneys of which cannot fail to attract the attention of any traveller.

The district south of Peterborough, through which the railway runs, and which is called "Fletton" or "Old Fletton" (hence the name of the bricks), has an underlying bed of clay many feet in depth; at a very small distance below the surface is the top bed, which varies from 6 feet to 10 feet in depth. This top bed is the plastic clay, and its under surface approximates to the horizontal; the varying contour of the ground gives the difference in thickness. Underlying this is the lower bed of shale or "knots," as it is locally termed, from which all the pressed bricks are made. This bed varies from 25 feet to 40 feet in depth, and is quite clean and free from sand, stones, or other matter which would injuriously affect the manufacture. Below this bed there is a layer of clay mixed in a greater or less proportion with small boulders, shells, and other *debris* of a like nature. As all the lime, stones, or shells have to be picked out of it for the good bricks, this lower bed has not been much used as yet. Below this it is understood there is another bed of good "knots."

However, it is with the main bed of knots that the brickmaker of the present time deals, and in this manner: The men "bar the stuff down," that is, with a long crowbar work vertical holes in the clay, in ledges, all down the face of the pit, knocking the detached portions into small trucks, which are placed close to the face at the bottom. These trucks are run on tramway lines, and are connected with suitable winding gear, by means of which each truck is hauled up into the grinding shed, which is usually on the first floor of the works, the presses being underneath. The grinding shed has in it one or more grinding pans, a machine something like a large mortar mill, having the outer portion of the bottom perforated. The clay is tipped from the truck into or near the grinding pan which is fed by a man, and as the clay is turned from large lumps into small, about the size of coarse oatmeal, it falls through the perforated portion of the pan on to the floor; thence it is distributed by elevators, etc., to the various parts of the floor required to serve the presses below, the holes in the floor being connected with the presses, which are directly underneath, by means of coarse canvas chutes. The presses are arranged on each side of a long building, if there are many; and, of course, in front of one side of this building should be the kiln, or kilns—or on both sides, if the works be large—as the bricks must be wheeled from the presses to the kiln, and the less the amount of manual labor the cheaper the output. The press has a hole in the iron table the size of a brick, with a bottom working up and down, and also a ram with a square head worked by an eccentric motion; the bottom is depressed, the square cavity filled with powdered clay (just sticky enough to adhere together when pressed tightly between the fingers), the square head comes down, presses the clay and rises; at the same time, the bottom rises, pushes the brick forward on the table, from which it is lifted by a boy and placed on the barrow, ready to be wheeled to the kiln, square, hard, with clean arrises, and fairly dry. Herein lies the secret as to how these bricks can be turned out at such a rapid rate and moderate cost; it is not ten minutes from the time the clay is "barred down" until it is in the kiln, if there is not a great accumulation of clay ready ground. No time is wasted in drying the bricks on the hacks, as is usual with the plastic clay, and, of course, the long process of weathering and tempering which is in use in the preparation of many of the brick earths is not required.

Many of the old Scotch or Dutch kilns are to be seen about the works at Fletton, but they are being superseded by some form of kiln similar to "Hoffmann's," the general arrangement being a large, oblong building in several compartments, 18 being a common number; these compartments are arched over, and communicate by means of flues with a chimney shaft. Each compartment has a doorway or opening at the ground level large enough to wheel the barrow in, the bricks are stacked up to the top, leaving spaces between each, and when the compartment is full the doorway is roughly bricked up and plastered over with clay, except a small opening at the bottom of the doorway or wicket, at which a small fire is made to help to dry and heat the bricks before the regular firing is commenced, when this hole is stopped up; then the fire is fed with small coal from a hole in the top or roof, about 4 inches in diameter, the amount of fuel used being, for these bricks, about 1 to 1½ cwt. of coal per 1,000 bricks burned. With a kiln of 18 compartments, one can be filled each day and one drawn, the intermediate compartments being in the various stages of heating, burning and cooling down.

It seems probable that the shale or "knots" possess some natural oil or gas which assists in the burning operation; this may be equivalent to the coal or cinders mixed with the clay in the case of stock bricks, as the amount of coal used appears very small.

The above is a general description of the methods adopted when dealing with the bed of shale or knots, and the bricks from it may be known by having some description of frog.

The top bed on plastic clay is ground, but in a plastic state, not dry as in the case of the knots, water being added to bring it to the proper consistency, to allow of its being forced out of the orifice at the end of the machine in a stick or band the size of a brick on edge, about 9 in. by 4½ in. This stick or band is cut into sections by means of wires arranged in a frame, each section being a brick without any frog, and may be distinguished by the marks of the wires on each bedding face. The bricks are then dried on the hacks or in a drying shed, or may be pressed in a machine, which gives them a better face, and also forms a frog. It is from this top bed, by the plastic process, that the white Fletton bricks are made.

The bricks, when well made, are good, being particularly well formed and hard; they have a clear ring when struck together, and are dense and compact when broken across. At the same time it is evident that unless care is taken in the manufacture they will not possess these qualities; if the shale is too dry, or if the supply to the machine be insufficient, or the pressure not enough, a poor brick with the particles not adhering to each other will be the result, having neither strength nor power to withstand the weather, particularly frost; and it appears that it would be to the advantage of the manufacturers if they took pains to turn out first-class goods, as there is no doubt that opinions vary as to the weathering qualities of the bricks, particularly as to the effect of frost combined with damp upon them. The outer skin of all machine-made bricks coming in contact with the oil or grease used in the machine no doubt helps to make a fine surface, but probably does not improve the weathering qualities. An object lesson in this respect may be seen in some portions of the brick facing of St. Pancras Station, where the coal wharfs are, parts of the original face of the bricks having entirely disappeared within the comparatively few years the station has been built.

As regards the strength of Fletton bricks, some accurate information is given in the second report of the brickwork tests carried out by the Science Committee of the Royal Institute of British Architects, published in December last. On page 100 of the report it is stated that Professor Unwin tested two samples of Fletton bricks, one marked "Plowman," the other without a mark, the crushing load of the first being equal to 202.7 tons per square foot, and of the second 239.0 tons per square foot. This stress is slightly higher than that given in the first report for Gault bricks, and lower than that of Leicester red bricks from Elliston. It seems important for the architect, engineer and builder in general, to bear in mind that single bricks, the crushing load of which will reach, say, 210 tons, will only carry from 20 to 30 tons before crushing when built in piers, or approximately only one-eighth of the load carried by the single brick, the actual figures being below this for work in mortar and above it for work in cement.

Natural Gas in Canada.

In the sixth annual report of the Canadian Bureau of Mines the following statistics representing the natural gas product of Ontario are given:

	1893.	1894.	1895.	1896.
Number of producing wells..	107	110	123	141
Value of gas product.....	$238,200	$204,179	$282,986	$276,710
Miles of gas pipe.....	117	183½	248	287½
Workmen employed.....	59	99	92	87
Wages for labor.....	$24,592	$53,130	$73,328	$47,527

There were 26 wells drilled during the year, 18 of which yielded gas, but of the total of 141 which are gas bearing eight are sealed up awaiting a market. In the Welland field as in former years the bulk of the gas is piped into Buffalo, and in the Essex field a large proportion of it was last year supplied to Detroit, in addition to the quantities consumed at Windsor and Walkerville.

The town of Leamington, in Essex county, offers a good illustration of what may be done by utilizing the bounties of nature for the public service. In 1892 the Ontario Natural Gas Company bored a well in Gosfield township, 3½ miles west of Leamington, and a flow of gas was struck at 970 feet. This proved to be one of the best wells in this district, the pressure of gas in it being 450 pounds per square inch. A pipe was laid to connect it with the town, and a supply service was put in under arrangements made with the the municipal council as to rates for fuel and light. For cooking stoves the rate was $1.65 per month, for heating stoves $1.90, and for furnaces $2.75; only one or two parties took gas by measure, and for these the rate was 12½ cents per 1,000 cubic feet. This service was continued until the fall of 1895, when a syndicate of citizens undertook to drill a well within the corporation limits on the understanding that the town would take it over if gas was found. The site selected was at the foot of Erie street, on the lake shore, and a flow of gas was struck at 987 feet with a rock pressure of 440 pounds per square inch. The town thereupon became the owner of the well at cost price, which was a little under $2,000, and the service plant was purchased from the Ontario Natural Gas Company at a valuation of $14,000.

A second well was bored last year at a distance of 100 yards from the first and gas struck at 997 feet. The two have a capacity as tested of 11,500,000 cubic feet per day, and it is estimated that the consumption does not exceed 150,000 cubic feet per day. The supply is drawn from the wells alternately, and in case an accident occurs to one of them, or its regulator requires to be cleaned out, the other is ready for use. Delivery pipes are laid on nearly every street, and about $6,000 was expended on extensions during 1895 and 1896. The total number of takers in the first of these years was 389, and the second 443, including a number of factories. The rates are slightly lower than those paid to the company, being $1.50 per month for cooking stoves, $1.75 for heaters, and $2.50 for furnaces; but in the case of heaters and furnaces the charge is only for seven months of the year, any gas consumed over that time being free. The factories and mills are metered, and the daily cost to the larger establishments runs from 25 to 50 cents per day, the rate being 5 cents per 1,000 cubic feet. When gas is consumed for light the charge is 16 cents per month for one burner, 15 cents each for two, and 14 cents for three or more, being the same as the rates charged by the company. For the care of the wells and plant only two men are employed, one of whom attends to the regulators and is paid $50 per month, while the other is paid $1.50 per day for attendance on the wells and putting in services. A system of waterworks was established in 1891 when a well was bored on the north side of the town to a depth of 47 feet in the drift. The drill went through 42 feet of clay and 5 feet of hard pan, when it dropped 2 or 3 feet into a bed of fine gravel like the lake shore sand. A 7-inch pipe was put in, and the water has been ascertained to rise 12 feet above the ground level; the capacity is over 30,000 gallons per hour. A second well was bored last year within 100 yards of the first, where an equally good flow was obtained at the same depth. Tests show, it is claimed, that the water of both wells is absolutely pure. Waterworks have been erected, 15 miles of service pipes have been laid down, and water is supplied to householders at $5 per annum. Factories are supplied free, and besides gas for fuel at the nominal rate of 5 cents per 1,000 cubic feet, they are exempted from taxation as far as the statute allows for a period of 10 years.

Some Random Notes upon Florida Gas Works.

By Traveler.

The philanthropic gentlemen who travel upon mileage or scalpers' tickets for the larger portion of the year, striving to increase the profits of "the house" by the sale of gas stoves or firebrick to the thousand or so gas companies of the United States, as a rule, find one company or one works pretty much like another, and but little in their travels to arouse their interest. Florida, however, is out of the ordinary. Its semi-tropical stretches of palmettoes and burning sand, its live oaks and bayous, its tourist life in winter, its "cracker" life in summer, and its tremendous insect life the year around, all mark it as different from the other States, and the *blasé* commercial traveler when he "strikes" the gas companies of the State almost unconsciously notes little differences visible in the gas works, and becomes interested in the earmarks of their environment.

This is, perhaps, scarcely so of Jacksonville. This city, the gateway to the State, handles most of its railroad, shipping, wholesale jobbing and commercial interests. It is eminently a business place. Tourists are glad to reach it and more glad to leave it. The gas company is conventional in most respects, thriving upon an output of 25,000,000 or so, most of which it sends out during the combined tourist, business and winter season.

In the summer the management can, and probably does, go fishing. Neither in Pensacola nor St. Augustine are there any points to be noted out of the ordinary. Both of these places are operated by the Philadelphia United Gas Improvement Company, and the local consumers get a good, intelligent, modern service. Pensacola was of interest a few years ago in having a plant of the Edgerton oil-water gas process, one of the old and early water gas forms from which for several years was distributed a 35-candle power gas through "dollars and cents" meters. That is, a form of meter in which the dial registered, not the amount of gas consumed but the value of it. This simplified the reading of meters by the customers themselves, but decidedly complicated matters when the gas company wanted to change the selling price of gas. The plant was finally replaced by a modern Lowe water gas apparatus since in use. The same kind of generators are naturally used by the United Gas Improvement people in St. Augustine. This is in many ways one of the livest companies in the State. St. Augustine in winter has lots of people, lots of shops, and lots of money in circulation. Like other resorts the gas output during the "season" is very high. In a permanent population of 6,000 or 7,000 the annual send-out is 15,000,000 cubic feet or more. Frozen services rarely bother the superintendent, and natural ice of any size mass is such a curiosity that, when a few years ago an icicle formed 7 or 8 feet long, on the side of the support of an outdoor, up-in-the-air, overflowing water tank, people drove for miles to see it, and photographs of it were sold to sight seers.

One can understand gas companies in the sizable cities above mentioned, but when one strikes down into the State and visits the other cities, the thought almost involuntarily arises, "What on earth keeps them going?" Take Sanford, for instance, a railroad junction point, at the head of navigation on the St. Johns river. When first laid out it had a great future of course, so, of course, a gas company was started; 3,000 is a high estimate of the population. The exact census figure in 1890 was 2,016. Imagine running a gas company and earning anything in a community of less than 1,000 whites! And yet, by shrewd watchfulness an output of 4½ million cubic feet a year has been built up, and a small dividend has been paid in Sanford—and earned, if ever dividend was. The plant is a Granger water gas one, shipped F.O.B. by the contractors, and erected by the gas company, an instance of the economy necessary at every point. Through some mischance the right hand "set" of producing machinery was erected left hand, and the gas passes through the scrubber backward. As, however, the capacity of the plant has never been severely taxed the public has not yet observed any difference or serious result from this dereliction. The "city" evidently does its best to support the gas company, as 69 lamp posts, at $25 each a year, are in use.

Not far from Sanford is the town of Orlando, said to have 5,000 population; actually 2,856 per 1890 census. The plant is also a Granger one; the city and conditions are largely similar to those ruling in Sanford. The price of gas, capital stock and bonds and output are also largely the same. It having, however, been in the hands of a receiver for a long time, one cannot help but reflect upon quality of the local management as a factor in the success or otherwise of small gas works.

Between Jacksonville and Sanford, midway on the St. Johns river, is Palatka, not a bad little town; but Oh! again, so small a place in which to run a gas works as to excite the sympathy of a Northern caller. Population (census) 3,039. However, what of it? Florida is a sandbar, and its gas men fight sand with "sand." The local superintendent not so many years ago in a New York works has buckled down to labor, and ground out a business of 5 or 6 million cubic feet in Palatka, of which a goodly percentage is in stoves, even in such a hot weather and cord-wood country. With a capital of $50,000, bonds $26,000, 70 lamp posts and a reasonable price for gas ($2 to $2.25), he shows some results, after all.

When one goes west from Palatka to Gainesville, one does realize that one is in Florida. The writer sat on the platform of a tiny box-car—on a narrow-gauge track—that was hauled by a wheezy locomotive, with a smokestack like a colossal peg top, from which came yel-

low pine cinders that burned holes in his hat. In due time the train stopped at Gainesville. The gas works were right across the tracks from the station. The writer stepped over to them, sized up the works, noted the tar, the junk and truck, the sleeping darky, the dilapidated outfit, the town hack lumbering off through the unpaved sand streets, the fact that there *was* a town in the distance, sighed, shook his head, and made again for the outgoing train which had brought him in but a few minutes before. Gainesville is said to have 2,790 people, an output of 2 or 3 million cubic feet, and to usually have the works running!

Tallahassee is another such, almost—excepting that its population of 2,934 and business are reinforced by the fact that it is the State capital. The works is a coal gas plant, snugly run and quietly efficient. The blossoms and the Legislature come and go, and, somewhat like Sanford, the local gas company, by close watchfulness, year in and year out, makes a little out of the business.

With all these thriving (?) county towns having their own gas works it was quite obvious that Ocala (2,904), in the very center of the State, the orange and the phosphate country, must also have its company. If others could support companies, Ocala could. So, about three years ago, a tidy little Lowe water gas works was erected. Poor Ocala! It happened exactly at the wrong time. The "great freeze" came and the orange groves were irretrievably ruined for six or eight years. Then the bottom fell out of the phosphate market, until an owner of phosphate lands, in selling 40 acres, would try to insert 80, to get rid of it, in the deed! On top of that the First National Bank failed, absorbing what little cash had been left in the county. That the Ocala Company has not flourished is scarcely to be wondered at. In the Ocala holder tank the experiment was tried of getting strength in the walls, not by mass or thickness of brickwork, but by a steel cage structure as a skeleton of strength, merely lined with brick for water tightness. This was all very nice on paper, but the vertical members of the skeleton cage unfortunately divided the brickwork up into sections. When the water was turned in, these panels bulged out and the tank leaked like a cider press, necessitating the addition of quite as much brickwork as would only ordinarily have been used in the first place.

Going on through the State to Tampa one finds a city that bids fair to rival Jacksonville, hitherto the chief city. By one of those inscrutable commercial movements that occasionally happen, the cigar business of Key West one day got up and removed to Tampa, transforming that city from 5,000 population to over 20,000. A gas works naturally followed, and it has prospered with the city in two scant years of growth. Also making water gas, it has over 250 street lamps, and an active business life to make it successful. The Cuban cigar making population, dwelling in their own Ybor City, while on the surface not a paying looking community, has in reality proved the best portion of the Company's business. Making good wages from rolling Garcias and the like, they spend every cent by Sunday night, in their gas light, café, semi Spanish, volatile existence. Even in the plainest of one story frame houses gas is frequently used by them.

The earmarks of Florida gas works are numerous. Buzzards are always soaring over the works. Colored labor is almost invariable. Pickaninnies are falling off the fence. Yellow pine is the staple wood. Where Northerners pay roundly for that splendidly firm and lasting timber the Florida man uses it for every structure or repair, as a matter of course. Open purifier houses are common. Why not? No steam heat is required; stormy weather is infrequent. Florida moss is a trademark of the State. The gas man uses it there to catch tar in his purifiers, packed in under the oxide as a mattress; the coon helper uses it, too, as a mattress behind the coal shed for an hour or two's nap after charging a bench.

The prevailing prices in the smaller towns are $2 to $2.50 for light; sometimes 25 cents less per 1,000 for fuel. In Pensacola the old Edgerton 35-candle power gas was sold at $3.50 to $4.50 per 1,000; but its day is long past; $2 and $1.50 are the present rates. And little enough, too, are these Florida prices—where oil is 6 or 7 cents a gallon, and coal $6 or $7 a ton; and telegrams north "$1 and 10"; where it takes a month to get a casting by freight, and where the price of a monkey wrench is as much as the profits for a week, sometimes! "Sand" is truly necessary to grind out dividends where most all conditions are against one. As one man said: "The only good thing we have down here is the absence of frost troubles."

Key West is sufficiently peculiar in its make up to warrant a separate consideration in some later notes.

AN option on the plant of the Lebanon (Pa.) Gas Company has been given. The option is to run until January 1, 1898.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Capital City Gas Light Company, of Des Moines, Iowa, have announced that, under the the agreement with the authorities, made in 1895, by which the Company's franchise was extended for a period of 15 years, which agreement specified that the Company should reduce the selling rate 5 cents each year until the minimum rate of $1 per 1,000 cubic feet was reached, have given notice that on and after January 1st, 1898, the net selling price will be $1.25 per 1,000. In addition to this 5 cents reduction each year, the Company pays into the city treasury the sum of 2 per cent. per annum on its gross receipts.

THE Buffalo (N. Y.) *News* says that the plant of the Citizens Gas Company, of Buffalo, will be shut down about the middle of January, it having been determined that the plant of the old Buffalo Company is quite up to furnishing all the gas required in the district supplied by the Citizens Company. Mr. George Fullerton, Sr., has been appointed Superintendent of Distribution of the combined Companies, and Mr. John Herron has been named Superintendent of the old Buffalo Company. If we mistake not, Mr. Herron was Superintendent of the Citizens Company, of Buffalo, for several years.

THE authorities of Ludlow, Ky., are considering the advisability of making a contract with the Cincinnati Gas Light and Coke Company for the supply of Ludlow with gas. The plan is to carry the supply pipe along the Southern bridge over the Ohio river.

THE Board of Supervisors of Poughkeepsie, N.Y., have awarded the contract for the lighting of the county buildings to the Poughkeepsie Gas Light Company, at its bid of $1.50 per 1,000 cubic feet. The contract is to cover the ensuing year. The rate for the current contract is $1.65 per 1,000.

THE authorities of Vassar College, N. Y., have agreed to install a gas engine of 5-horse power, to furnish power required in the laboratory. This installation is in the nature of a working trial, since the further determination is, should the initial engine answer the requirements, to equip the College with a gas motor sufficient to respond to all its power demands.

THE authorities of Carterville, Ga., are still undetermined in respect of the proposition as to whether or not it would be a wise thing for them to construct and operate on public account a lighting plant.

THE Board of Street and Water Commissioners, of Jersey City, N. J., invite sealed proposals for the lighting of the streets of that city, in so far as that service is performed by gas lamps or oil lamps, the proposals to be opened at 2 P.M. to-day. The minimum number of lamps to be maintained is: Gas, 300; oil, 300.

TIFFIN, Ohio, is again in trouble over its natural gas plant. The lease granted to Patrick Dowling, whereby the latter has done with it the best he could for himself, has been annulled, and other bids for its leasing are now to be solicited.

THE proprietors of the Trenton (N. J.) Gas Light Company have notified their consumers that, on and after January 1, 1898, the selling rate will be $1.50 per 1,000 cubic feet. This move goes to show that Mr. Chambers and his associates are not disposed to allow the opposition concern—the recently chartered Peoples Gas Improvement Company—to capture the gas supply of Trenton without a struggle.

THE Board of Equalization, of Louisville, Ky., has decided not to raise the assessment of the Louisville Gas Company for the purposes of taxation. We do not see how a different determination could be fairly reached, since the Company now stands rated at $400,000 on real estate account, and at $900,000 on personal account.

ADVICES from Belvidere, Ills., are to the effect that Messrs. Richard McCarty, James Porter, Calvin Pease and T. R. Jackson have entered suits against the Belvidere Gas Light and Fuel Company, the basis of the claims being that the location of the Company's plant in proximity to their properties has damaged their holdings, each in the sum of $1,000.

MR. E. H. JENKINS, who has been Superintendent of the Covington (Ky.) Gas Light Company for some years, has been appointed Chief Engineer of the Buffalo (N. Y.) combined Companies.

A DISASTROUS explosion occurred, on the afternoon of the 7th inst., in the boiler room of the Citizens Light, Heat and Power Company, of Portsmouth, Va. The plant was completely wrecked.

THE Flushing (L. I.) Gas and Electric Company has placed the contract for the extension of its generator plant with the Berlin Iron Bridge Company, of East Berlin, Conn. This extension will be built in fireproof manner, having steel framework and trusses covered with corrugated iron.

"W.," WRITING from Paris, Ills., under date of the 3d inst., says: "It may interest you to know that the case of Henry Pratt & Co. of Chicago, against the Paris Gas Light and Coke Company, has been decided in the Supreme Court of the United States in favor of the defendants. This is but an affirmation of the judgment rendered in the Circuit Court and the Supreme Court of Illinois. The facts of the matter in controversy are in brief as follows: The Gas Company had contracted with Pratt & Ryan for a water gas plant, the total cost of which was to have been $6,000. When the same was virtually completed the Gas Company was notified that the process was an infringement on patents held by the Springer Manufacturing Company, of Springfield, which was proved. Under the circumstances they would have been stopped by injunction had they attempted to use the system and they very properly refused to accept or pay for the plant. Messrs. Pratt & Co. brought suit for the contract price, the case being brought in the Circuit Court. The verdict was against plaintiffs. The Supreme Court of the State affirmed the decision, and the case was then taken to the Supreme Court of the United States, with the result as stated above. The Hon. George Hunt, of Chicago, represented the Gas Company in the Court of last resort."

THE Elizabethtown Gas Light Company, of Elizabeth, N.J., has completed the piping of the contiguous district of Cranford, and proposes to pipe the Westfield district as soon as the necessary permission has been granted by the Westfield Township Committee.

A CORRESPONDENT, writing from Atlanta, Ga., under date of the 6th inst. says: "The offer recently made by the City Council of Cartersville, Ga., to the Cartersville Light and Power Company, involving the purchase by the former of the Company's gas plant, at the stated price of $7,500, has been answered by the Company, through its President, Judge John W. Aiken. The Company refuses to accept the city's offer, but agrees to sell the plant for $10,000, or to accept the valuation put on the plant by a board of three appraisers, one to be named by the city and one by the Company, the two select a third. After some debate the Council agreed to the arbitration plan."

THE Salt Lake (Utah) *Herald* says: "The Farmers Loan and Trust Company, of New York, has entered suit in the United States Circuit Court against the Salt Lake and Ogden Gas and Electric Light Company, *et al*, to recover $1,500,000 and interest on first mortgage bonds of the first named defendant Company, issued January 1, 1893, and payable January 1, 1918, in gold coin of the United States, or in sterling in London, at the option of the holder. The interest on the bonds is at the rate of 6 per cent. per annum, payable semi-annually, and it is provided that if default is made for a period of three months in the payment of the interest that the bondholders may declare the entire principal to be due and payable forthwith. It is also provided that a sinking fund should be formed for the liquidation of the principal, and that on or before November 1, 1895, 1½ per cent. of the principal should be paid into said fund, and a similar amount every year until the whole is paid. It is then set up that the Salt Lake and Ogden Company has paid nothing into the sinking fund, and that it defaulted in the interest due July 1, 1897. The bonds are secured by a mortgage on all the real and personal property of the Company in Salt Lake and Ogden, and it is alleged that the Company is insolvent and the mortgaged property could not be sold to advantage at once; wherefore the plaintiff prays that a receiver be appointed to take charge of the property and to dispose of it in the most advantageous manner possible, and so also prayed that an injunction issue restraining the defendants from disposing of the property pending the hearing of the suit, and that plaintiff may have judgment for any deficiency which may exist after the sale of the property under the mortgage. The Union Light and Power Company, which absorbed the Salt Lake and Ogden Gas and Electric Light Company, is made a party to the suit. * * * It is claimed by some that the foreclosure proceedings were instituted at the instigation of the majority stockholders of the Salt Lake and Ogden Gas and Electric Light Company, who favor the consolidation, to squeeze out the minority, who object to the Company being absorbed by the Union Company."

THE changes in the plant of the Framingham Gas, Fuel and Power Company, of South Framingham, Mass., have been completed, and the residents agree that the gas now supplied them is vastly better for fuel and illuminating use than the so-called fuel gas which it superseded.

AT a meeting of the City Council, of Grand Junction, Col., D. R. Crosby and others applied for a franchise for a gas works. They ask for a right covering a period of 20 years, and agree to charge not in excess of $1.25 per 1,000 cubic feet.

AT a special meeting of the stockholders in the Newark (N. J.) Gas Company, held on the 6th inst., for the purpose of giving the Directors power to increase the capital stock in the sum of $4,000,000 ($2,000,000 preferred, and to be entitled to a dividend of 6 per cent. per annum, the balance to be common stock), over seven-eighths of the present capital ($1,000,000) participated in the voting. The vote was unanimous in favor of the issue. The original shares (par value $100) are $220, bid.

THE gas plant on the gas stove works of Messrs. George M. Clark & Co., at Harvey, Ills., is up to a capacity of 80,000 cubic feet per day—a 10,000-foot holder is part of the equipment. The constructor was Mr. F. D. Moses, of Chicago.

THE properties of the Goshen (N. Y.) Gas Light Company will be sold at foreclosure on February 23, 1898. The sale is ordered in consequence of a default in payment of interest on a mortgage of $12,000, executed by Mr. E. D. Bushnell, President, to Mr. W. S. Stewart, Trustee.

MR. H. M. HANTZMAN has resigned the position of Superintendent of the city gas works, Alexandria, Va. Captain R. M. Latham has been temporarily appointed. Meanwhile the authorities are "looking around" for a "permanent appointee."

THE Peoples Gas Light and Coke Company has been formed to take over the properties of the Queen City Gas Light Company, of Buffalo, N. Y. The succeeding corporation is capitalized in $3,000,000, and its incorporators are Messrs. P. H. Griffin, F. C. M. Lantz, William F. Wendt, Frank B. Baird, H. St. Clair Denny, T. Guilford Smith, John A. Kennedy, Herbert P. Bissell and W. C. Cornwell.

AT a special meeting of the Mount Vernon (N.Y.) Common Council, Alderman Ultcht, of the Committee on Street Lighting, offered a resolution (which was adopted) authorizing the Committee to have the gas supplied by the East Chester Gas Company tested, for the purpose of determining whether the quality is up to the standard demanded under the contract between the city and the Company.

MR. JOHN A. MANLY and Mr. Richard Armstrong are named as the prime movers in the project to establish and operate a gas works in Rossland, British Columbia. As we understand it, they propose to construct a coal gas works.

PLEASONTON, Cal., is talking gas and electric lighting. Messrs. Frank J. Moffit and Dennis Bernal, of Livermore, Cal., are said to be the parties in interest.

THE new holder for the Woburn (Mass.) Company is of the two-lift order. The dimension of the tank is 55 feet by 20 feet, of the lower lift, 53 feet by 20 feet, of the upper lift, 51½ feet by 20 feet.

THE *Gas World* says that the big fire which recently laid waste between four and five acres of property in the neighborhood of the London General Post Office has been the subject of general comment, and various theories have been advanced to account for the outbreak, among them being that the fire originated in an explosion of gas. So far, however, no evidence has been forthcoming in support of the theory, and inquiries made at the distribution headquarters of the Gas Light and Coke Company, in Goswell Road, show that nothing is known of a gas explosion there. It has been also stated that enormous volumes of gas escaped during the conflagration, adding fuel to the flames. As to this, the officers of the Gas Company estimate that the quantity of gas lost could not have been more than 500,000 or 750,000 cubic feet, which would be but a small contribution to the grand total of combustible material. In addition to this quantity of gas the Company lost 149 meters, ranging in size from 3 lights to 100 lights, and

(*Continued on page* 934.)

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PROPRIETORS.

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MONDAY, DECEMBER 13, 1897.

(*Continued from page* 933.)

also 60 gas stoves. It appears that when a fire breaks out it is the practice of the Company to cut off the supply from the affected area at every possible point; but, in a case such as the present one, when the fire spread with great rapidity, it is not always possible to reach the particular valves that it is desirable to close, and even when they can be reached it is frequently found that they have been so warped by the heat that they are unworkable. When this occurs the only thing that remains is to cut and plug the pipes. This was done in every possible case at the fire referred to, and, in addition, the Company had a staff of men continually on the watch to close valves at points where the fire was threatening to spread. This watching policy resulted in no fewer than 14 valves being closed at different points where danger threatened. In reference to the report that the escaping gas hampered the operations of the firemen, it is interesting to know that frequently the gas is left on by special request of the officers of the Fire Brigade, the light it produces enabling the men to carry on their operations more effectively when they are called upon to contend against a fire at night.

On the Impurities of Commercial Carbides of Calcium.

Chemical News reports Mr. H. Le Chatelier found the study of the impurities of carbide of calcium to be interesting on account of the indications it can give as to the reciprocal affinities of certain bodies when heated to a temperature of about 2,000°.

After calcium and carbon, the two most abundant elements present are silicon and iron. It is possible that definite combinations of either of these bodies may exist with each of the other three; which are those, we may ask, which are formed by preference at the temperature of solidification of calcium carbide?

The iron, which is the least abundant of the four elements under consideration, might be entirely saturated by one or the other of the remaining three. As a matter of fact it is combined exclusively with the silicon. It is detected by treating the hydrated carbide with an acid, and suspending the insoluble residue in iodide of methyl. Small crystals of silicide of iron are precipitated; these have been studied by M. Moissan; by analysis they have been proved to be $SiFe_2$.

The excess of silicon combines either with the carbon or with the calcium, according to the relative proportions of these two bodies; if the quantity of carbon present is in excess of the calcium, a silicide of carbon is formed, crystallizing in apparently hexagonal plates, and generally of a blue color. It is found, with the excess of graphite floating on the surface of the iodide of methyl. If, on the contrary, the quantity of calcium is in excess of the quantity of carbon present, a silicide of calcium is formed, which is disseminated throughout the mass of the carbide in the form of metallic grains, having the color and luster of zinc. These can be isolated by rapidly quenching the carbide in a large excess of cold water, separating by levigation the coarser residues, and washing them for a few moments with a solution of acetic acid. The final residue is composed of silicide of iron and of the coarsest grains of silicide of calcium, which have withstood the rapid washings intended to isolate them. In such a case there would be neither graphite nor silicide of carbon present, for this reason, that the calcium must be in excess to allow of the formation of silicide of calcium. In fact, the determining affinities which govern the combination of these elements are those of iron for silicon, and of calcium for carbon. These are first satisfied, and the remaining bodies combine amongst themselves in a manner varying according as one or the other is in preponderating proportion.

There seem to exist two distinct silicides of calcium; one of them is hardly attacked by nitric acid, but is, on the contrary, easily attacked by hydrochloric acid, with the formation of an insoluble yellow matter, called *silicone* by Wöhler. The other, easily attacked by nitric and acetic acids, gives, with hydrochloric acid, a deposit not yellow but white, which, like *silicone*, is soluble in potash, with an abundant disengagement of hydrogen.

In the attack of silicide of calcium we more frequently get the yellow and white compounds together. The analyses of these mixtures lead one to suspect compounds between those corresponding to $Si_2O_3H_4$ and $Si_2O_3H_6$. For example, one analysis gave—

Yellow matter	0.52 grm.
Hydrogen given off (0° and 760 mm)	630 c.c.
Silica	0.57 grm.

Which corresponds exactly to the second formula.

The Market for Gas Securities.

The prevailing condition in the city gas share market for the past week has been that of doubt. All classes of local gas securities are decidedly weaker, perhaps the greatest shrinkage having been shown in Standard common, which is 135 bid to-day (Friday) as against 139 at time of last writing. Consolidated opened to day at 184½ bid, and by noon had sold down to 181¼, chiefly on suggestions by speculators that the consolidation proceedings had been suspended for a period likely to be long. Meanwhile we may remark that Consolidated has been steadily absorbed by people who know very well what they are doing. The Stock Exchange has listed 8,000 additional shares of Consolidated stock, which it is understood has been sold for the purpose of insuring the taking up at maturity of certain outstanding bonds. This brings the total capital issued up to $36,230,000. We repeat our advice that those who hold their shares will eventually be well repaid for their tenacity; nor would it surprise us to hear at any time that the merger was ready for completion. The meeting set for the 14th inst. is awaited with interest. Mutual is offered at 340.

Brooklyn Union is weaker, at 118½ to 119, and Peoples, of Chicago, is undeniably strong, at 96 to 96¼. More newspaper information, dated to-day, is to the effect that the New England Gas and Coke Company has acquired control "of some or all" of the Boston Gas Companies; but the safest way just now in connection with the matter is to wait a while before saying that anything certain has been accomplished. Meanwhile, Bay State is dull and steady, "between 5 and 6." Consolidated, of Baltimore, is a trifle stronger, as are Lacl des. The balance of the list shows no particular change. The Welsbach Light Company has declared a dividend of $1 per share (20 per cent.), payable the 23d inst.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

DECEMBER 13.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	181	182
Central	500,000	50		..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	280	290
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	321	340
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	..	
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	79	81
Preferred	2,000,000	100	98	104
Bonds 1st 5's	3,500,000	1,000	112*	113
" 1st Con. 5's	1,500,000	..	105	106½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	135	140
Preferred	5,000,000	100	145	150
Bonds, 1st Mortgage, 5's	1,500,000	1,000	114	115
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	118⅛	119
" " Bonds (5's)	15 000,000	1,000	112½	113
Bay State	50,000,000	50	5⅞	6
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	93⅛	97
2d " " "	3,000,000	1,000	..	83
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Company	25,000,000	100	97¼	97¾
Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,069,000	.	91	94
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	..
" Bonds	600,000	1,000	101	103
Cincinnati G. & C. Co.	8,500,000	100	206	207
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	54¼	54¾
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..

Detroit	4,000,000		55	57
" Con. Bonds	4,312,000	..	97	97½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	93
" Bonds	2,000,000	..	93	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	118	125
" Bonds, 6's	2 650,000	..	107	109
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	86	88
Bonds	1,000,000	1,000	92	94
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	44½	45
Preferred	2,500,000	100	93	95
Bonds	9,034,400	1,000	103	103½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	96	96½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	21½	22
Bonds	1,000 000		94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	83	85
Bonds, 5's	3,556,000	.	102	103
Wilmington, Del.	550,000	50	200	202

Advertisers' Index.

GAS ENGINEERS.

Page

Wm. Henry White, New York City ... 955
Fred. Bredel, Milwaukee, Wis ... 940
Geo. R. Rowland, New York City ... 955
The Western Gas Construction Co., Fort Wayne, Ind ... 946
Humphreys & Glasgow, New York City ... 942
American Gas Co., Phila., Pa ... 940
David Leavitt Hough, New York City ... 957
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 955

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 953
United Gas Improvement Co., Phila., Pa ... 945
Burdett Loomis, Hartford, Conn ... 954
National Gas and Water Co., Chicago, Ills ... 947
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 955
The Western Gas Construction Co., Fort Wayne, Ind ... 946
Humphreys & Glasgow, New York City ... 942

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City ... 956
Continental Iron Works, Brooklyn, N. Y ... 954
Deily & Fowler, Phila., Pa ... 956
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 952
Stacey Mfg. Co., Cincinnati, Ohio ... 955
Bartlett, Hayward & Co., Baltimore, Md ... 953
Davis and Farnum Mfg. Co., Waltham, Mass ... 952
R. D. Wood & Co., Phila., Pa ... 954
Isbell-Porter Company, New York City ... 954
Fred. Bredel, Milwaukee, Wis ... 940
United Gas Improvement Co., Phila., Pa ... 945
Berlin Iron Bridge Co., East Berlin, Conn ... 942
National Gas and Water Co., Chicago, Ills ... 947
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 955
The Western Gas Construction Co., Fort Wayne, Ind ... 946
Humphreys & Glasgow, New York City ... 942
Gas Engineering Co., Pittsburgh, Pa ... 952
American Gas Co., Phila., Pa ... 940
Logan Iron Works, Brooklyn, N. Y ... 956
Riter-Conley Co., Pittsburgh, Pa ... 939

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City ... 955
R. D. Wood & Co., Phila., Pa ... 954
James R. Floyd's Sons, New York City ... 956
Continental Iron Works, Brooklyn, N. Y ... 954
Gas Engineering Co., Pittsburgh, Pa ... 952
Logan Iron Works, Brooklyn, N. Y ... 956
Riter-Conley Co., Pittsburgh, Pa ... 939
Kirkham, Hulett & Chandler, London, Eng ... 949

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 953
Fred. Bredel, Milwaukee, Wis ... 940
J. H. Gautier & Co., Jersey City, N. J ... 950
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 950
Adam Weber New York City ... 950

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City ... 955
R. D. Wood & Co., Phila., Pa ... 954

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich ... 936
G. Shepard Page's Sons, New York City ... 955
Gas Engineering Co., Pittsburgh, Pa ... 952

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 960
American Meter Co., New York and Philadelphia ... 959
Helme & McIlhenny, Phila., Pa ... 959
D. McDonald & Co., Albany, N.Y ... 957
Nathaniel Tufts, Boston, Mass ... 958
Maryland Meter and Mfg. Co., Baltimore, Md ... 958
Metric Metal Co., Erie, Pa ... 958
Keystone Meter Co., Royersford, Pa ... 958
Buhl Stamping Company, Detroit, Mich ... 959

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia ... 959
John J. Griffin & Co., Phila., Pa ... 960
D. McDonald & Co., Albany, N. Y ... 957
Helme & McIlhenny, Phila., Pa ... 959

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio ... 957
M. J. Drummond, New York City ... 957
R. D. Wood & Co., Phila., Pa ... 954
Warren Foundry and Machine Co., New York City ... 957
Donaldson Iron Co., Emaus, Pa ... 957

PIPE CUTTERS.

The Anderson Pipe Cutter Co., Marlboro, Mass ... 939

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y ... 947

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 949
Perkins & Co., New York City ... 948
Despard Gas Coal Co., Baltimore, Md ... 949
Westmoreland Coal Co., Phila., Pa ... 949
Berwind-White Coal Mining Co., New York and Phila ... 948
W. D. Althouse & Co., Phila., Pa ... 949

CANNEL COALS.

Perkins & Co., New York City ... 948
W. D. Althouse & Co., Phila., Pa ... 949

GAS ENRICHERS.

Standard Oil Co., New York City ... 949
The Sun Oil Co. Pittsburgh, Pa ... 949

COKE.

Pittsburgh Gas and Coke Co., Pittsburgh, Pa ... 937

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 949

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City ... 936

GAS GAUGES.

The Bristol Co., Waterbury, Conn ... 938

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 947
Isbell-Porter Co., New York City ... 954
The Wilder Mfg. Co., Phila., Pa ... 938
R. D. Wood & Co., Phila., Pa ... 954
Wm. M. Crane & Co., New York City ... 938

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City ... 954
Continental Iron Works, Brooklyn, N.Y ... 954
G. Shepard Page's Sons, New York City ... 955
Logan Iron Works, Brooklyn, N. Y ... 956
R. D. Wood & Co., Phila., Pa ... 954

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y ... 950

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J ... 950
B. Kreischer & Sons, New York City ... 950
Adam Weber, New York City ... 950
Laclede Firebrick Mfg. Co., St. Louis, Mo ... 950
Cyrus Borgner, Phila., Pa ... 950
James Gardner, Jr., Pittsburgh, Pa ... 950
Henry Maurer & Son, New York City ... 950
Baltimore Retort and Firebrick Co., Baltimore, Md ... 950
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 950
Brooklyn Firebrick Works, Brooklyn, N. Y ... 950
F. Behrend, New York City ... 939

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa ... 944

THORIUM.

The Roessler & Hasslacher Chemical Co., N.Y. City ... 937
Dr. Philipp Hirsch, Berlin, Germany ... 936

INCANDESCENT LIGHT PREPARATIONS.

Dr. Philipp Hirsch, Berlin, Germany ... 936

MICA GOODS.

The Mica Mfg. Co., New York City ... 936

BURNERS.

C. A. Gefrorer, Phila., Pa ... 954
Theo. Clough, Dobbs Ferry, N. Y ... 936
Wm. M. Crane & Co., New York City ... 938

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn ... 938

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila ... 937

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 947
Greenpoint Chemical Works, Brooklyn, N.Y ... 936
Henry W. Douglas, Ann Arbor, Mich ... 947
Gas Purification and Chemical Co., Ltd., London ... 947

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind ... 941
Isbell-Porter Company, New York City ... 954
Connelly Iron Sponge and Governor Co., New York City 947

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 946
Chapman Valve Manufacturing Co., Boston, Mass ... 946
R. D. Wood & Co., Phila., Pa ... 954
Continental Iron Works, Brooklyn, N. Y ... 954
The P. H. & F. M. Roots Co., Connersville, Ind ... 941
Isbell-Porter Co., New York City ... 954
The Western Gas Construction Co., Fort Wayne, Ind ... 946

ELECTRICAL APPARATUS.

Wm. Henry White, New York City ... 955

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa ... 920
The American Gas Engine Co., Phila., Pa ... 951
Backus Water Motor Co., Newark, N. J ... 896

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City ... 936
W. G. & G. Greenfield, East Newark, N. J ... 896

PURIFIER SCREENS.

John Cabot, New York City ... 933

GAS STOVES.

American Meter Co., New York and Philadelphia ... 943
Maryland Meter and Manufacturing Co., Baltimore, Md. 958
Keystone Meter Co., Royersford, Pa ... 958
Wm. M. Crane & Co., New York City ... 938

INSTANTANEOUS WATER HEATERS.

Gilbert & Barker Mfg. Co., New York City ... 937

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J. P. Whittier, Brooklyn, N. Y ... 946

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Kerr Murray Mfg. Co., Fort Wayne, Ind ... 952
Stacey Mfg. Co., Cincinnati, Ohio ... 955
R. D. Wood & Co., Philadelphia, Pa ... 954
Logan Iron Works, Brooklyn, N. Y ... 956
Riter-Conley Co., Pittsburgh, Pa ... 939

GAS SECURITIES.

Marquand & Parmly, New York City ... 936

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
DREXEL BUILDING, PHILA., Dec. 8, 1897.

The Directors have this day declared a dividend of One Dollar per share, payable Dec. 23, 1897, to stockholders of record at the close of business Dec. 14th. Checks will be mailed.

1175-2 EDWARD C. LEE, Treas.

Position Wanted

As Superintendent of Gas Works.

Has had 19 years' experience in the manufacture and distribution of water gas, in works with a capacity of 100,000 to 5,000,000 cubic feet per day. Best of references. Address

1169-7 "W. J. B.," care this Journal.

GAS ENGINEER AND CHEMIST,

age 32, is open to take charge of a coal, oil, or water gas plant. Will travel for responsible firm. Has had experience in working inclined retorts. First-class references and testimonials. Address

1172-6 "G.E.C.," care this Journal.

Wanted, to Purchase or Lease,

A Gas Works in a Town of 5,000 to 10,000 Population, Near New York.

Or would buy a controlling interest. Particulars will be treated confidentially. Address

1172-3 "G. A. S.," care this Journal.

Wanted, to Purchase or Lease,

A Gas Plant in a Town of from 8,000 to 20,000 Inhabitants.

The States of Illinois, Indiana, Ohio or Michigan preferred.

1173-4 Address "H. T.," care this Journal.

FOR SALE,

at a bargain,

Two 50-H P. Otto Gas Engines,

in first-class condition.

Address WOONSOCKET GAS CO.,

1175-tf Woonsocket, R. I.

FOR SALE.

The undersigned will sell

All the Property of the Connersville Gas and Electric Company,

on January 27, 1898. Write for full information.

1175-4 P. S. FLOREA, Receiver, Connersville, Ind.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

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FOR SALE.

Hydraulic, Dip, Branch and Ascension Pipes, Mouthpieces and Lids, for four Benches of 5's and for one Bench of 3 retorts.

Two Coolers, or Air Condensers, each of 150 000 cubic feet capacity.

Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tubes, 10 ft. 6 in. long.

D-Shaped Tar Extractor, 8 ft. long, 1 ft. 6 in. deep.

Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

8-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

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Pure Thorium.

Guaranteed of great light-giving power; regularly supplied at a reasonable price. Address

F. Y., 6965, care of Rudolf Mosse,

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E. H. Nickel Tips for Water Gas a Specialty.

THEO. CLOUGH, - - Dobbs Ferry, N. Y.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator,

Not Expensive. Write to

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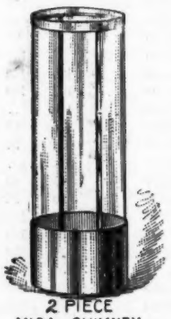
Our Mica Chimneys



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For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

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CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

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Specially designed for handling material in and around

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Before you forget it, send for a copy of our new, 40-page, illustrated Catalogue, No. 9703, fully describing this Industrial Railway.

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EQUIPPED WITH

SQUARE FURNACE, SQUARE GRATE SURFACE, STEEL JACKET, LINED WITH BRICK.

Single Boilers or Compact Batteries.

GREAT SAVING OF FUEL AND FLOOR SPACE.

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Shipping Facilities by River and Rail.

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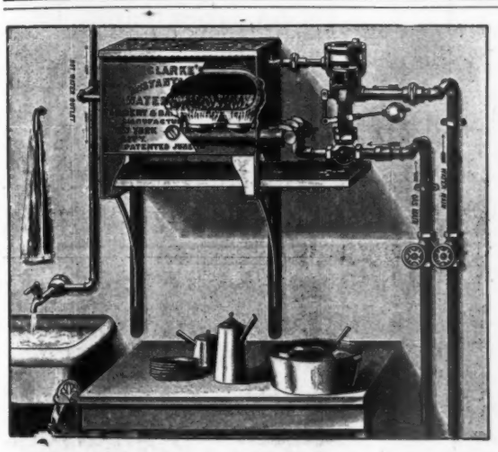

Clarke's Automatic Instantaneous Water Heater.

This Heater furnishes water heated as it flows. The act of drawing water from any faucet with which it is connected automatically turns on the gas, which is in the same way instantly shut off when the flow of water is stopped at the faucet. It will deliver a gallon of water a minute as long as required, at a temperature 80° higher than it is delivered to the Heater; or it will deliver a less amount at a higher temperature, or a greater amount at a lower temperature, as may be determined by regulating the flow at a faucet. We have testimonial letters from those using it in Private Residences, Factories, Barber Shops, Restaurants, Stables, Laboratories, Stores, Churches, Commercial Buildings (for scrubbing), Banks, Clubs (baths, shower baths and sprays), Hotels, Riding Academies (baths and shower baths), and Patrol Stations

Price, $50.00. 12 inches wide, 15 inches high, 30 inches long. Weighs 86 lbs.

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——OWNS, CONTROLS AND OPERATES——
EXCLUSIVELY

THE NEW IMPROVED AND PATENTED STREET LIGHT BURNER.

STYLE No. 81.

Our PATENTED "STREET LIGHT APPLIANCES" have made WELSBACH STREET LIGHTING a complete success.

By the UNIFORM DISTRIBUTION of light on scientific principles a greater area can be lighted by our system and more economically than in any other way.

Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

Our System is in practical use in many cities, among which we may mention

NEW YORK CITY.	WORCESTER, Mass.	PROSPECT PARK, Brooklyn.
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ITHACA, N. Y.	BROOKLINE, "	NEW HAVEN, Conn.
COLLEGE POINT, N. Y.	FREEHOLD, N. J.	BEAVER, Pa.

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CORRESPONDENCE SOLICITED FROM GAS COMPANIES AND OTHERS INTERESTED IN MUNICIPAL LIGHTING.

BRAY'S BURNERS

Are Suitable for All Pressures and Conditions, and for Efficiency, Economy and Durability are Unrivaled.

Producing a steady, well-shaped flame with burner cock turned on full. Prevent waste of gas, broken globes and dissatisfied consumers.

As Sole Agents in the United States for GEORGE BRAY & Co., we carry a full stock of all sizes for High and Low Pressures. Send for Prices and Special Pamphlet, or order a sample gross, stating your average house pressure.

Every Burner is stamped with name and trade mark. Cheap and inferior imitations are constantly coming in and going out of use, and we respectfully warn the trade against this kind of deception, as it causes loss and discredit to the trade and damage to the gas industry.

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Gas Logs, Fires, Heaters,

OF ALL KINDS.

GAS GOVERNORS,
GAS FURNACES,
and everything pertaining to the use of Gas.

SEND FOR CATALOGUE.

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Broilers, Griddles, Ovens, Etc.

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Special Line of Gas Appliances for Hotels.

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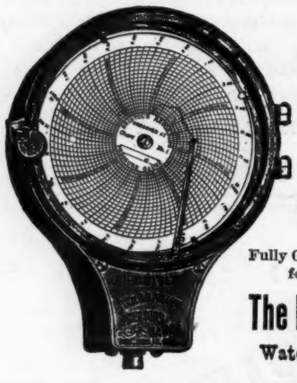

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PRESSURE GAUGE.

For continuous records of **Street Gas Pressure**

Simple in Construction, Accurate in Operation Low in Price.

Fully Guaranteed. Send for Circulars.

The Bristol Co.,
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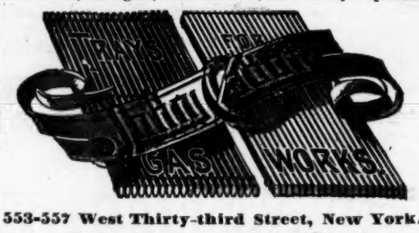
Special Trays for Iron Sponge or Oxide of Iron,

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.



553-557 West Thirty-third Street, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.

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UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

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ON THE CONSTRUCTION AND WORKING OF

Regenerator Furnaces,

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Has been made by

WILDER'S VOLUMETRIC GOVERNORS.

They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.

WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.

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Having compiled a novel Chart or Map illustrating the various

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THE Patent "Standard" Washer-Scrubber

(U. S. A. Patent, No. 486,927 of 29-11-'92.)

Order Recently Received—16 Machines, each for 3,500,000 Cubic Feet per day.

The Patentees of the above, after several years' experience, finding that the enormous weight of the iron sheets (forming the washing discs) caused undue wear of the shafts and consequent fractures of the latter, introduced their Patent Wooden "Grid Segments." These "segments" have now been fitted in some hundreds of Patent "Standard" Washer-Scrubbers, and are universally admitted to be a great improvement upon the out of date pattern.

The Patentees beg to refer Engineers to recent issues of the AMERICAN GAS LIGHT JOURNAL for testimonials as to the efficiency of their improvements and will be glad to quote for complete machines or for "grid segments" for fitting in old pattern Washer-Scrubbers, the manufacture to be English or American at enquirer's option. If for any *special reason* iron sheets are preferred, the Patentees will quote for them, but they do not recommend same.

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GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

THE ANDERSON Patent Cutter Carrying Link
Made in all sizes.

Will cut from 2 in. to 24 in.
Pipe Cutting Tool

For Cutting Cast, Wrought Iron, Gas & Water Pipes.
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102 Milk Street, Boston, Mass.

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SOLE IMPORTER OF THE CELEBRATED
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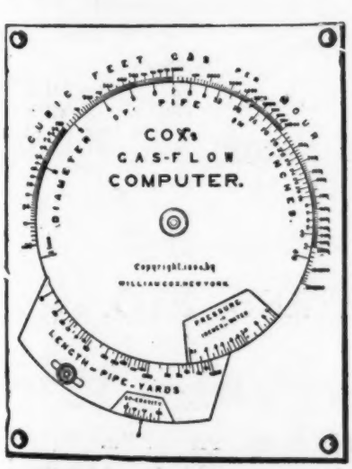
BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,
Stettin "Anchor" & "Eagle" Brand Portland Cement
10 & 12 Old Slip, New York.



Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.
2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.
3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.
4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

It Prevents Errors and Saves Hours of Tiresome Calculations.

Price, $5.00, per Registered Mail.

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A. M. CALLENDER & CO., 32 Pine St., N. Y. City.

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

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Recuperative Furnaces, Washers, Condensers, Purifiers and Purifying Machines, Ammonia Plant, Coke Conveyers, Etc.

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Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

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NEW GAS GOVERNOR AND STEAM VALVE.

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MORE DIRECT IN ACTION. FEWER PARTS.
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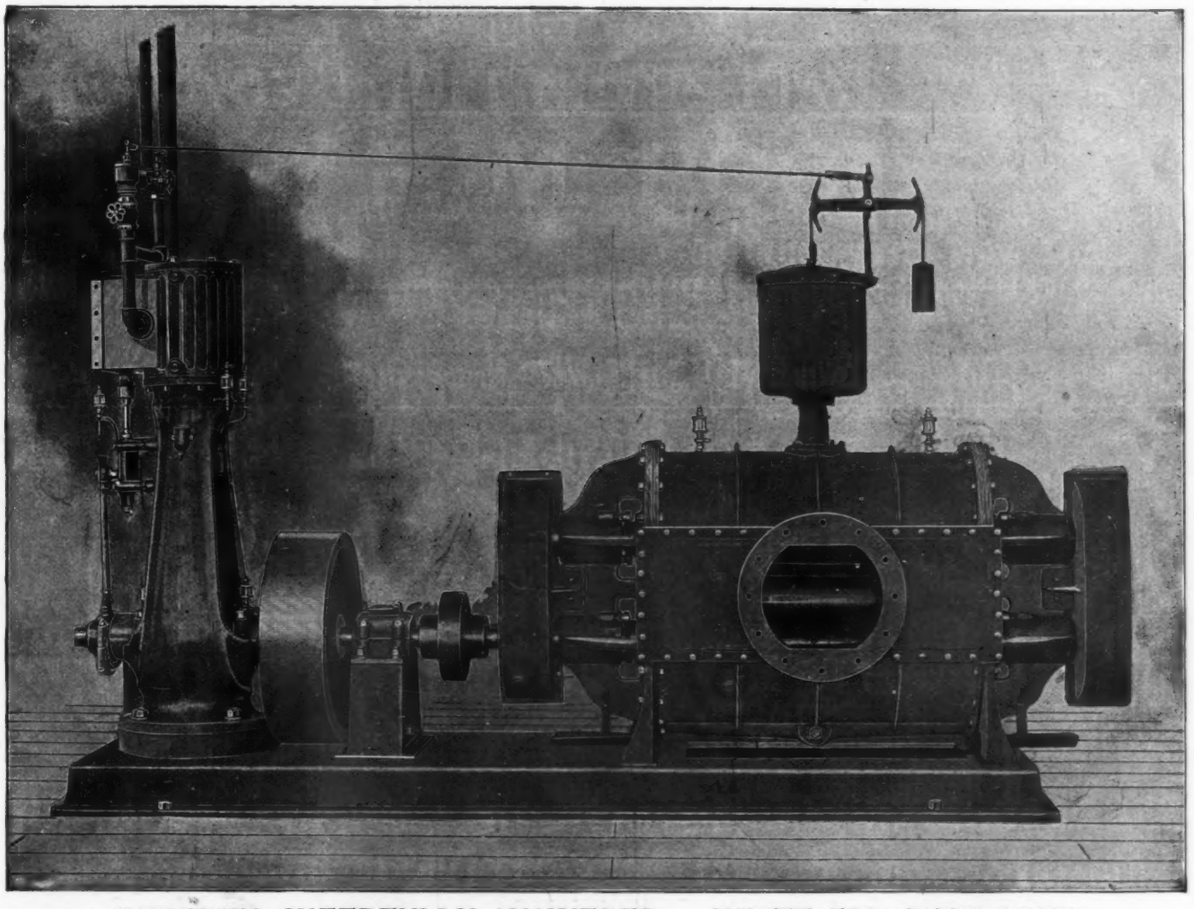

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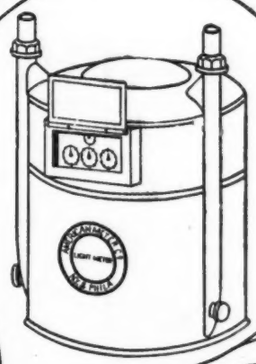

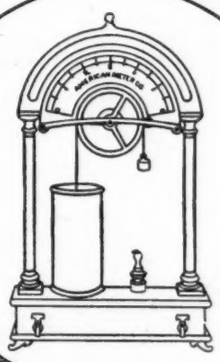

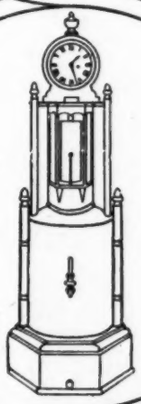

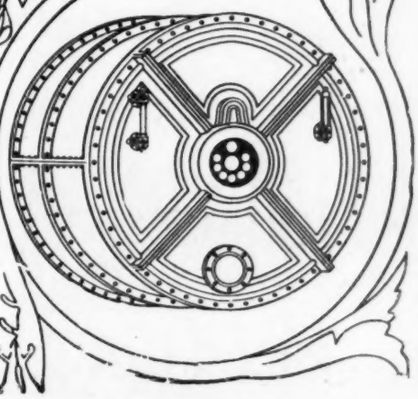

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AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

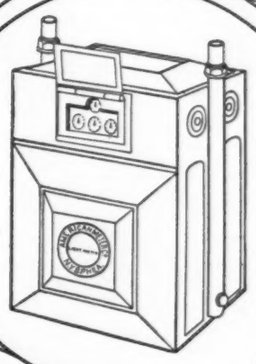
PUBLIC LIGHTING TABLE.

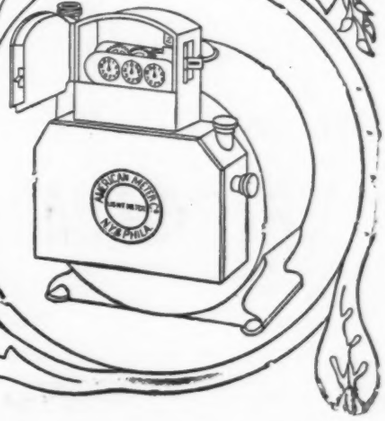
DECEMBER, 1897.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Wed.	1	11.50 PM	6.00 AM	4.20	6.10
Thu.	2	12.50 AM	6.00	4.20	6.10
Fri.	3	1.50	6.00	4.20	6.15
Sat.	4	2.50	6.00	4.20	6.15
Sun.	5	3.50	6.10	4.20	6.15
Mon.	6	4.50	6.10	4.20	6.15
Tue.	7	No L.	No L.	4.20	6.15
Wed.	8	No L. FM	No L.	4.20	6.15
Thu.	9	No L.	No L.	4.20	6.15
Fri.	10	5.00 PM	6.40 PM	4.20	6.20
Sat.	11	5.00	7.40	4.20	6.20
Sun.	12	5.10	8.50	4.20	6.20
Mon.	13	5.10	9.50	4.20	6.20
Tue.	14	5.10	10.50	4.20	6.20
Wed.	15	5.10	12.00 AM	4.20	6.20
Thu.	16	5.10 LQ	1.00	4.20	6.20
Fri.	17	5.10	2.10	4.20	6.20
Sat.	18	5.10	3.20	4.20	6.20
Sun.	19	5.10	4.40	4.20	6.20
Mon.	20	5.10	6.20	4.20	6.20
Tue.	21	5.10	6.20	4.20	6.20
Wed.	22	5.10	6.20	4.20	6.20
Thu.	23	5.10 NM	6.20	4.20	6.20
Fri.	24	5.10	6.20	4.20	6.25
Sat.	25	5.10	6.20	4.20	6.25
Sun.	26	5.10	6.20	4.20	6.25
Mon.	27	5.10	6.20	4.20	6.25
Tue.	28	9.30	6.20	4.20	6.25
Wed.	29	10.40	6.20	4.20	6.25
Thu.	30	11.40 FQ	6.20	4.20	6.25
Fri.	31	12.40 AM	6.20	4.20	6.25

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355 25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45





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WE have learned that the makers of the "Sunlight" lamp assert that there has been a decision in the English Courts which saves them and their customers from liability as infringers of the Welsbach patents.

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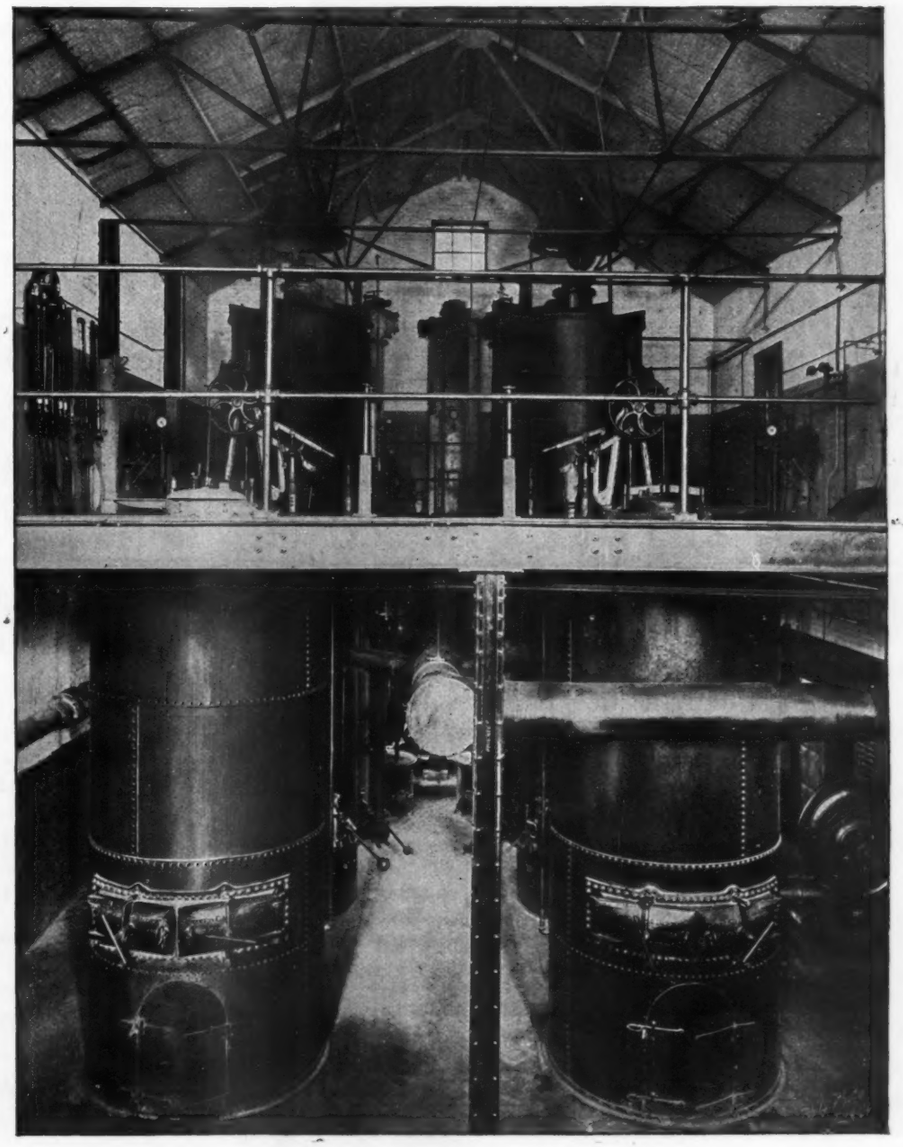

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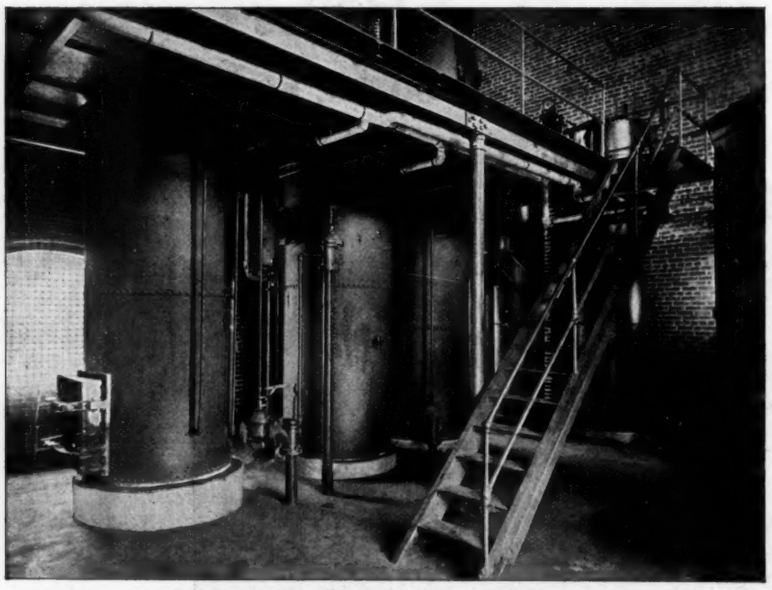

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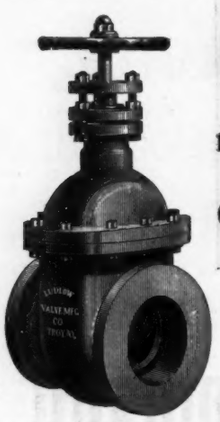

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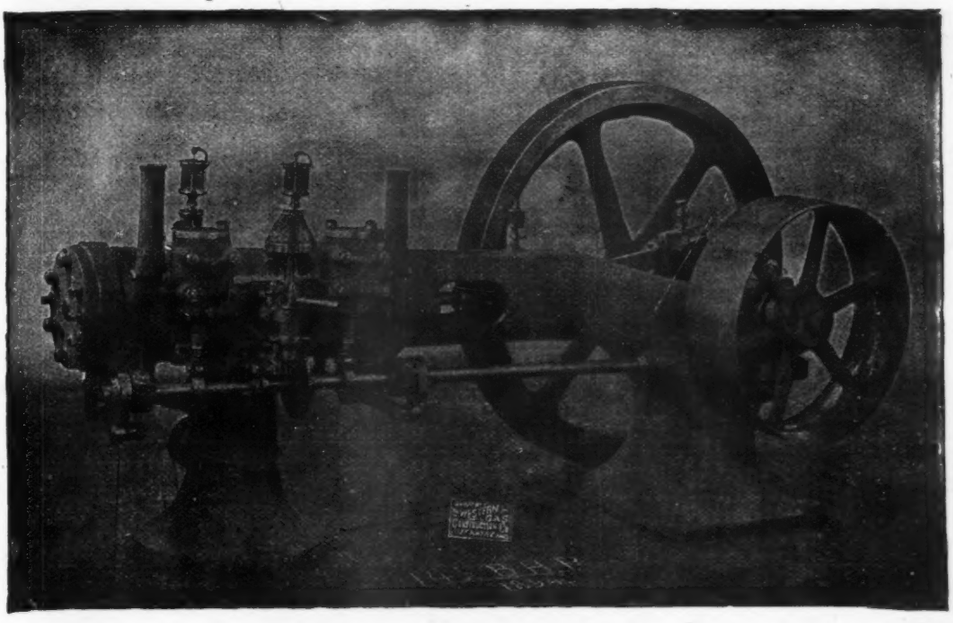

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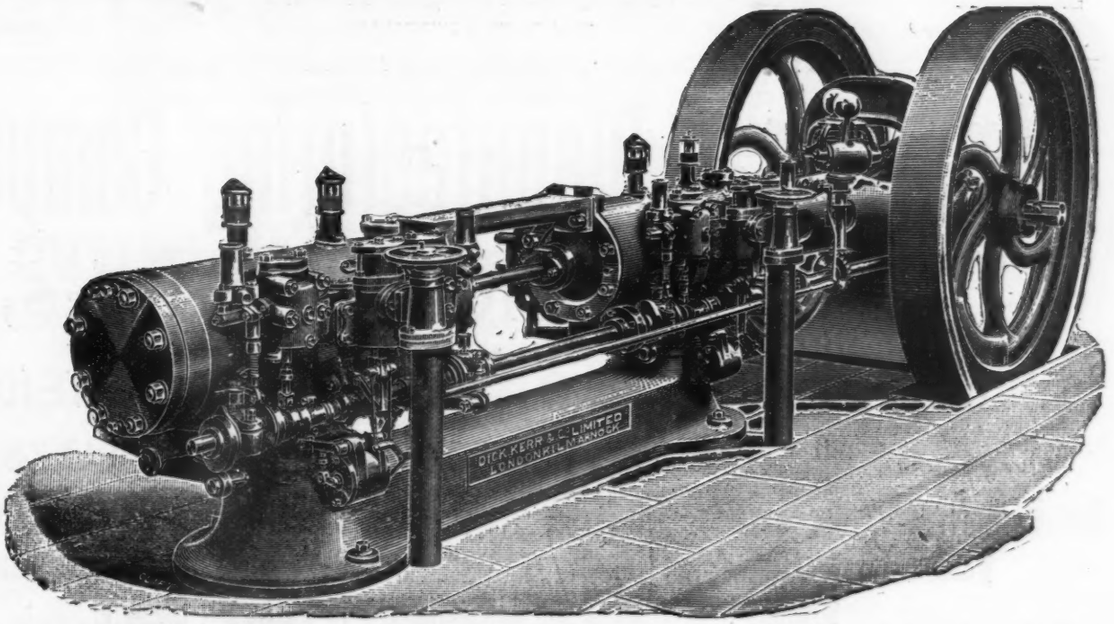

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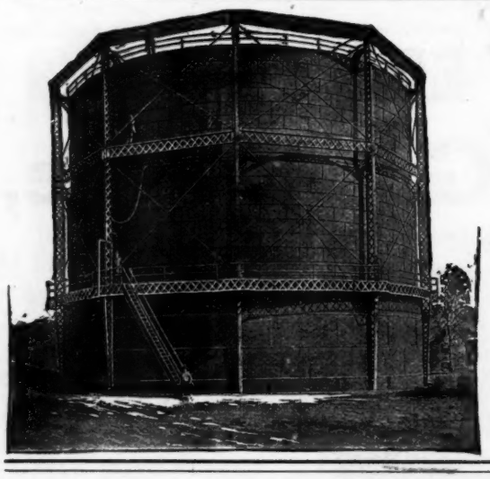

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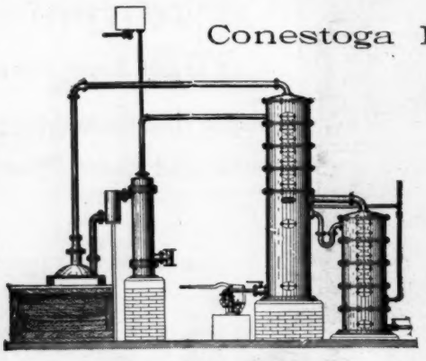

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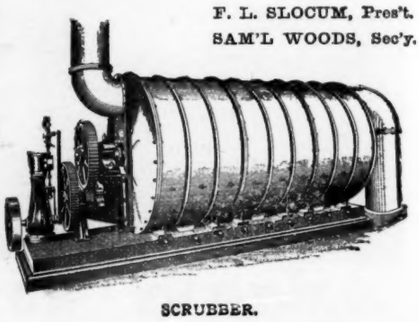

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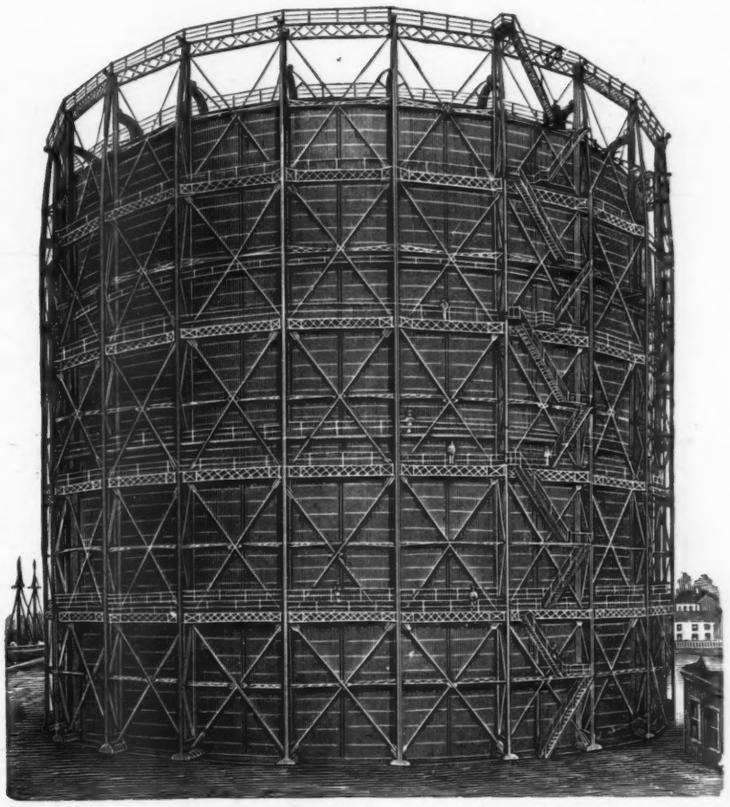

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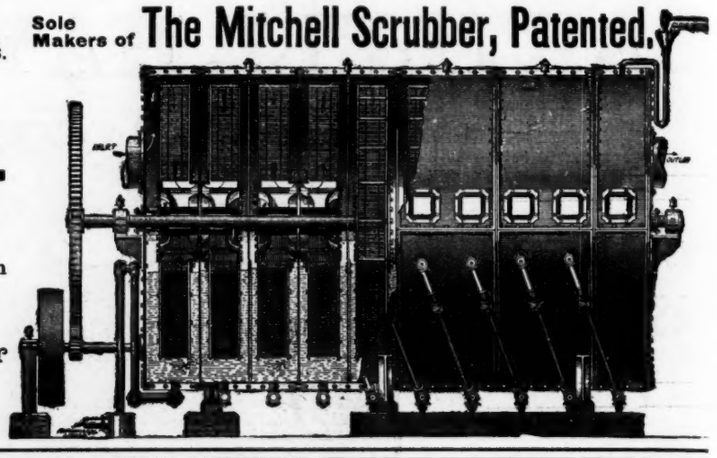

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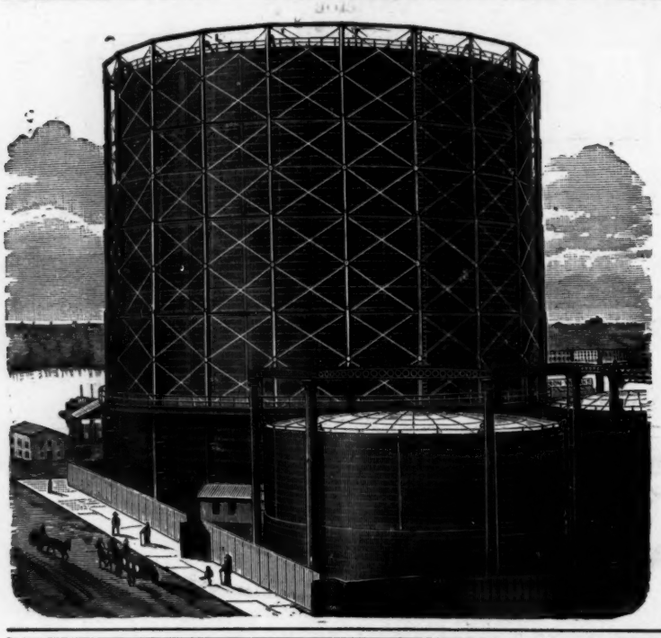

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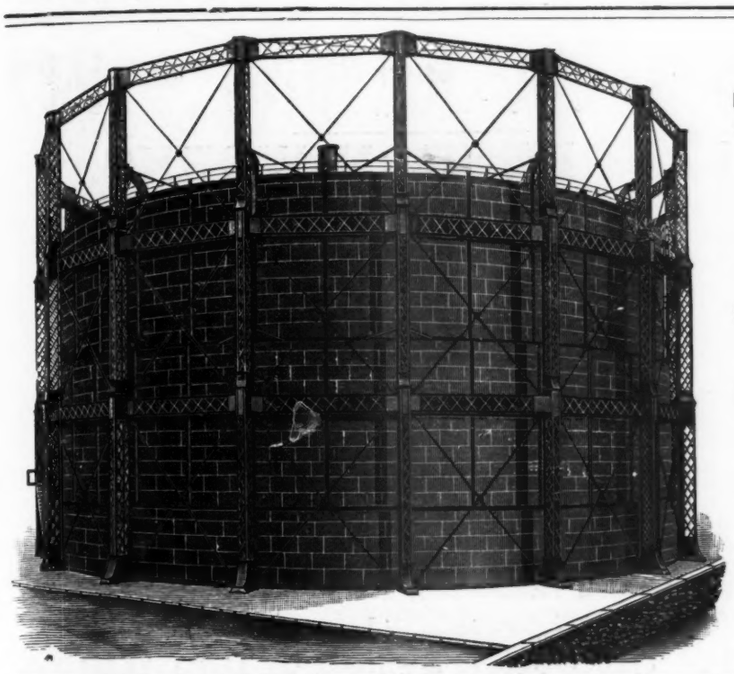

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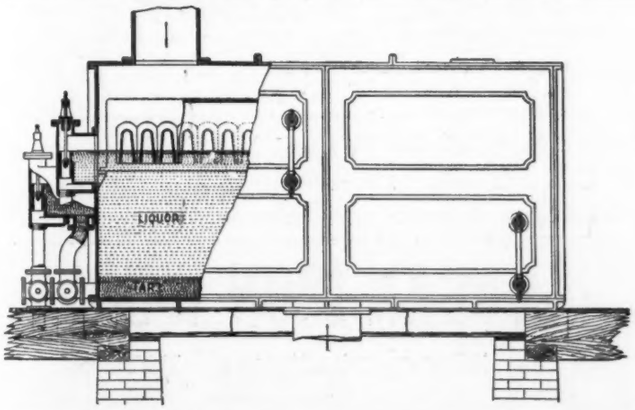

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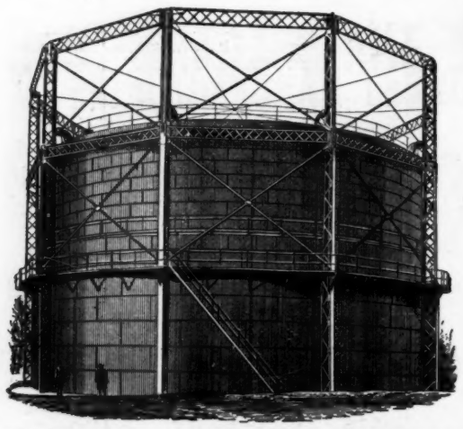

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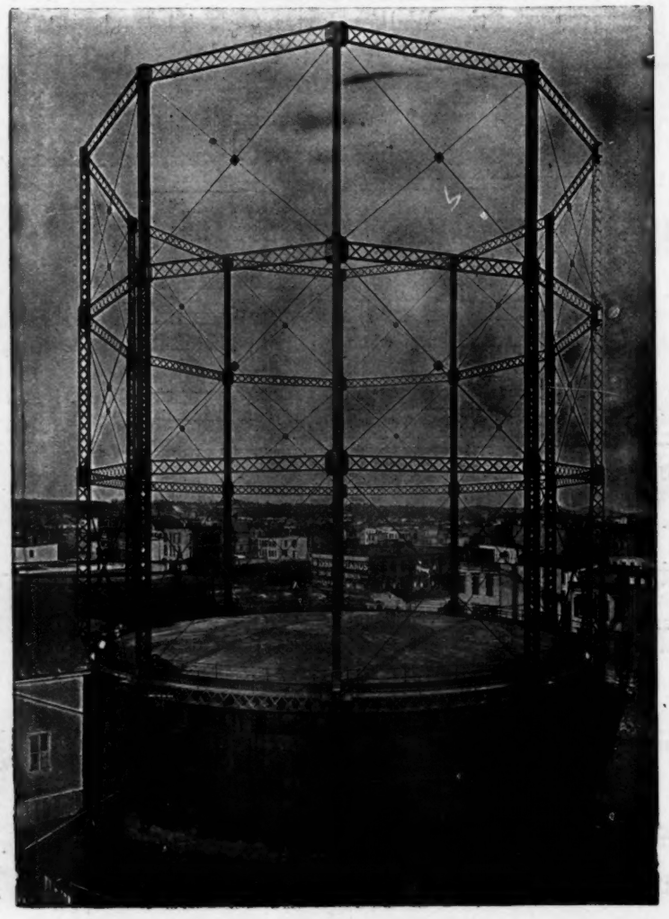

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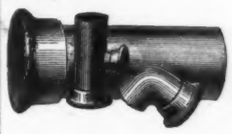

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